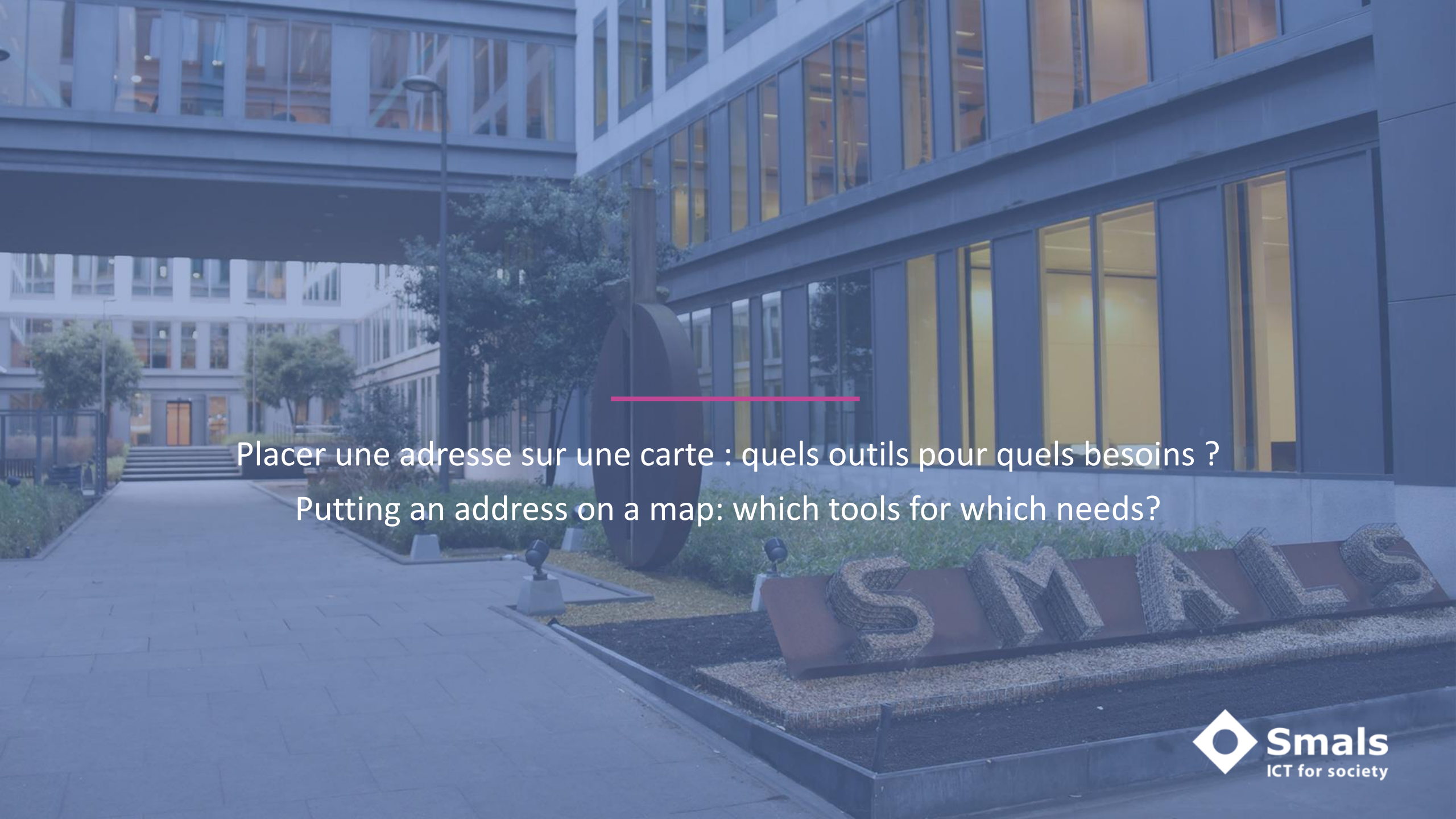
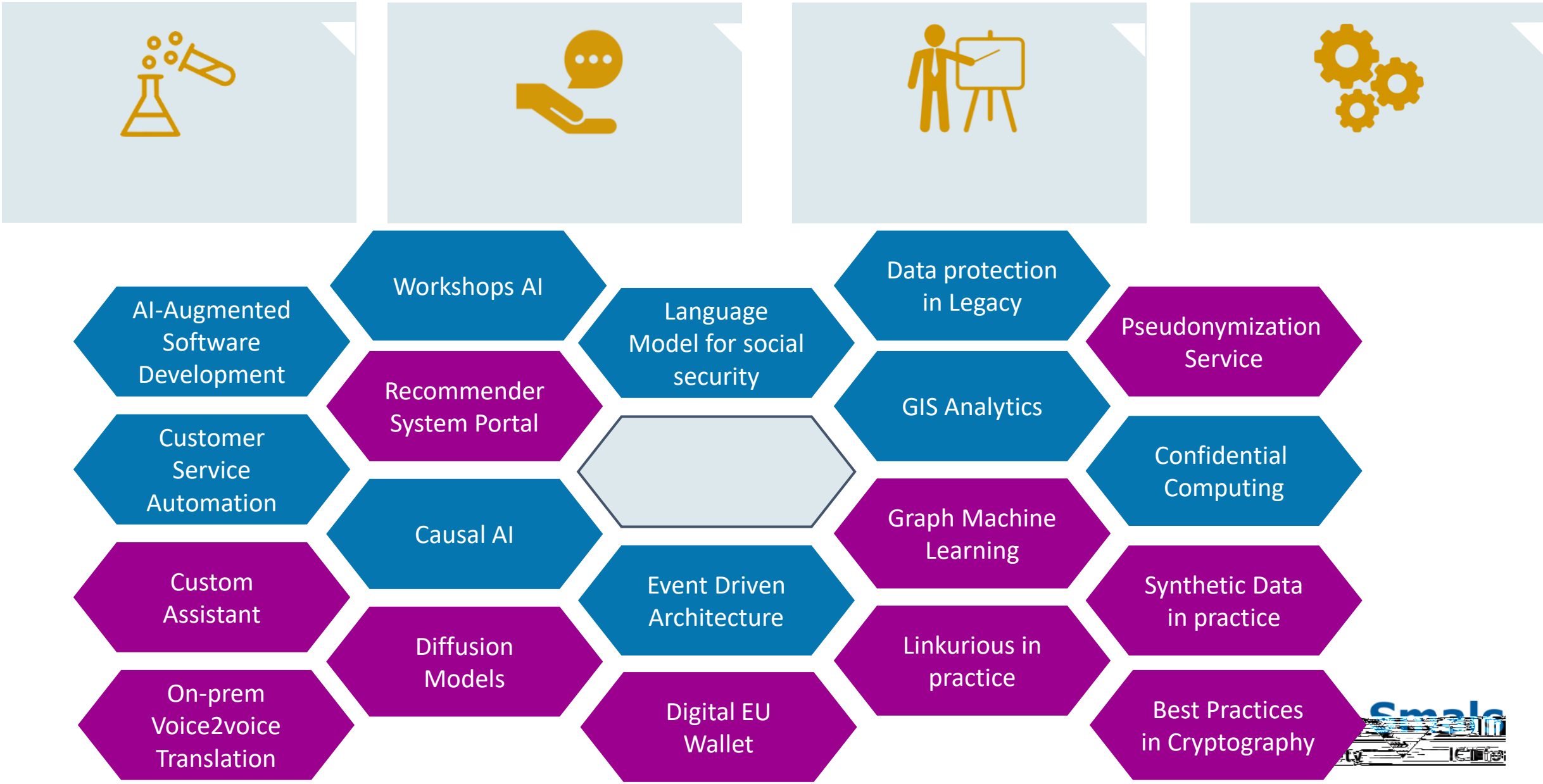
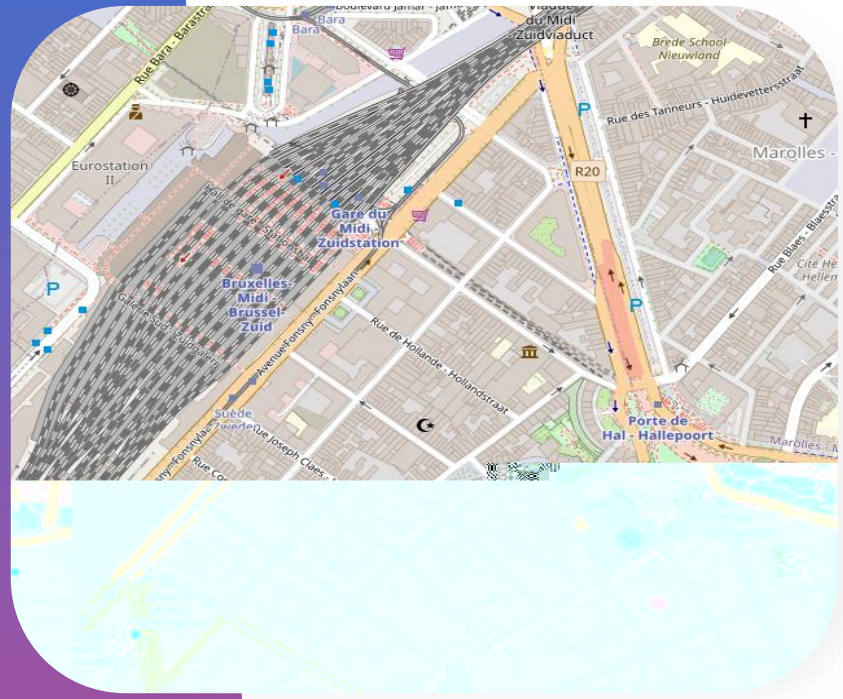


Placer une adresse sur une carte : quels outils pour quels besoins ?

Putting an address on a map: which tools for which needs?

Smals
ICT for society


AI-Augmented Software Development
Workshops AI
Language Model for social security
Data protection in Legacy
Pseudonymization Service
Recommender System Portal
GIS Analytics
Customer Service Automation
Confidential Computing
Causal AI
Graph Machine Learning
Custom Assistant
Event Driven Architecture
Synthetic Data in practice
Diffusion Models
Linkurious in practice
On-prem Voice2voice Translation
Digital EU Wallet
Best Practices in Cryptography



- Concepts
- Evaluation
- Nominatim based solution
- BestAddress+Nominatim based solution
- Pelias based solution
- Conclusion

Map: OpenStreetMap

Map: CadGIS

-
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  -
- Evaluation
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- Conclusion

“Av. Fonsny 20, 1060 Bruxelles”

```
{“street”  : “Avenue Fonsny”,
 “housenbr”: “20”,
 “zipcode” : “1060”,
 “city”    : “Saint-Gilles”,
 “country” : “Belgique”,
 “location”: [50.8358,4.3361]}
```

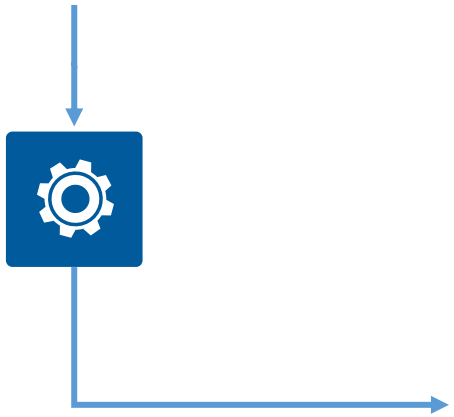
Address standardization = Mapping
Geolocation = « side effect »/bonus

"Av. Fonsny 20, 1060 Bruxelles"

…	…	…	…	…
Avenue Fonsny	20	1060	Saint-Gilles	50.8358, 4.3361
Avenue Fonsny	22	1060	Saint-Gilles	50.8359, 4.3358
…	…	…	…	…

```
{"street"   : "Avenue Fonsny",
 "housenbr": "20",
 "zipcode"  : "1060",
 "city"     : "Saint-Gilles",
 "country"  : "Belgique",
 "location": [50.8358,4.3361]}
```

lat: 50.8358, lon: 4.3362, range: 10m

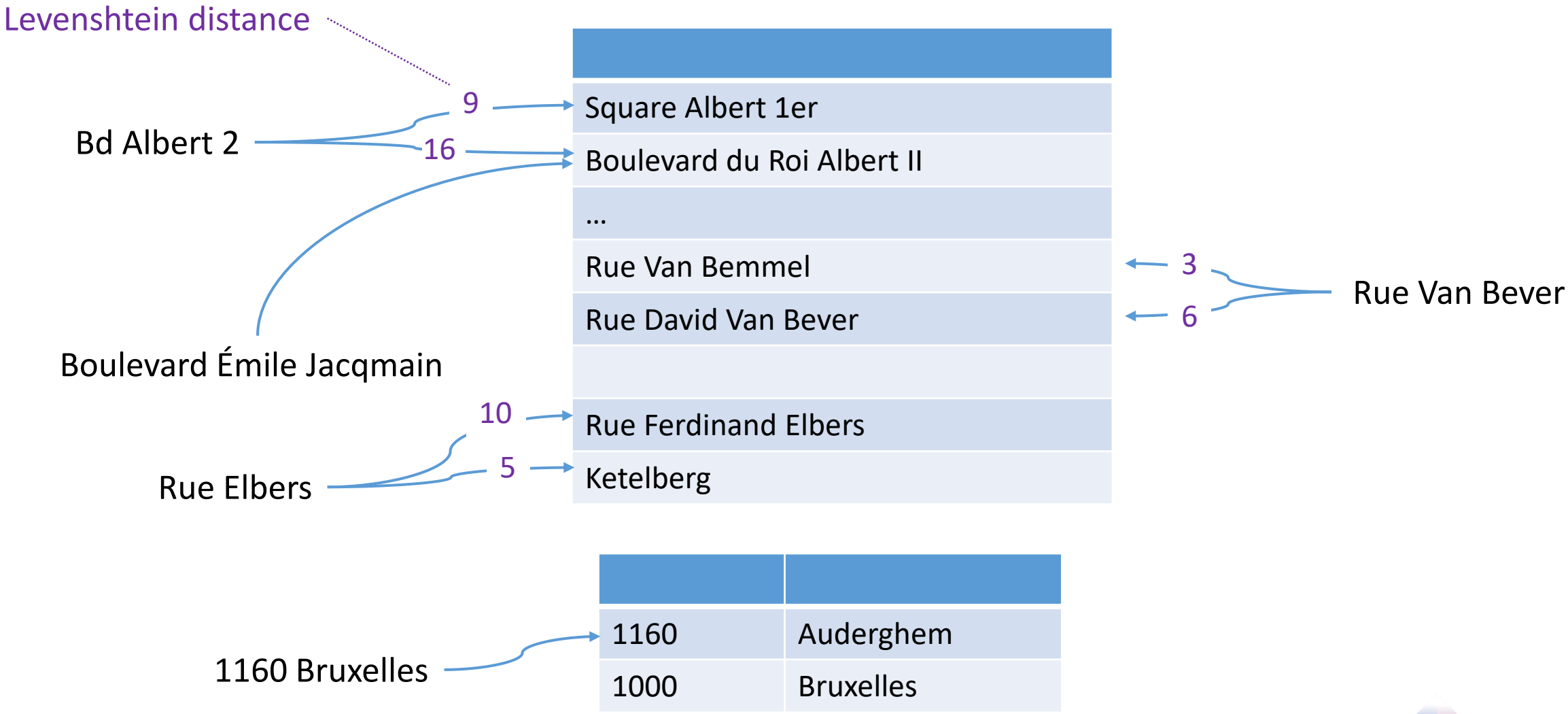



```
{“street”   : “Avenue Fonsny”,
 “housenbr”: “20”,
 “zipcode” : “1060”,
 “city”     : “Saint-Gilles”,
 “country” : “Belgique”,
 “location”: [50.8358,4.3361]}
```

“Av. Fonsny 20, 1060 Bruxelles” ➔

```
{“street”  : “Av. Fonsny”,
 “housenbr”: “20”,
 “zipcode” : “1060”,
 “city”    : “Bruxelles”}
```

- Very complex problem looking very simple!
  - Not always « Avenue Fonsny 20, 1060 Saint-Gilles »
  - « 1600/2 Chée de Wavre, 1160 Bruxelles »: easy for a human, not for a computer
- Box information : “10 A”:
  - “housenumber”: “10 A”,
  - or “housenumber”: “10”, “box”: ”A” (10/A, 10 bt A, 10 apt A…)
- Addresses often contain extra/useless info:
  - Smals, Avenue Fonsny…
  - Avenue Fonsny 20 (Saint-Gilles), 1060 Bruxelles
  - « Sonnez ‘Tartempion’ », « Au dessus de la poste »…



1160	Auderghem
1000	Bruxelles

1160 Bruxelles

Many quasi-homonyms ; exm in BRU: Lapins vs Lupins vs Lutins, Augustins vs Augustines, Savoir vs Lavoir, Cologne vs Pologne

- Cloud commercial providers:
  - Here we go
  - Bing maps
  - Google maps
  - TomTom
- Sometimes free in specific conditions

- Mainly 3 open-source/open-data solutions:
  - OpenStreetMap/Nominatim
  - Photon (OSM + ElasticSearch)
  - Pelias
- On-premise possible for a specific region

Geocoder = API - standardization - geolocation

- Trillium @ Smals (Data Quality tool):
  - API: OK ; Standardization: OK (for millions of records)
  - Geolocation: NO

- BeST (BestAddress/BOSA) API:
  - API: OK ; Geolocation: OK
  - Standardization: (almost) no cleansing (assumes correct addresses)

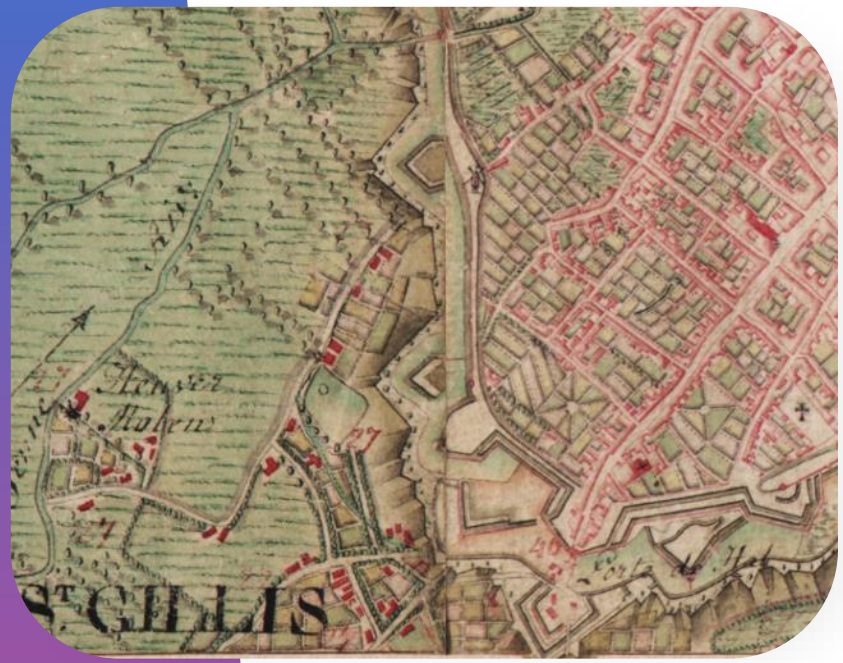
- PhacochR (Paradigm (ex CIRB/CIGB) + IGEAT (ULB)):
  - Standardization: OK ; Geolocation: OK
  - API: NO, only batch

Setup complexity		
Infra costs		
GDPR, Confidentiality		
Cost for large volumes (time, €)		
Internet access		
Quality		
Worldwide coverage		

- In most cases, geocoding response is a JSON (or XML) document
- Beside geocoded address, geocoders (often) provide a quality indicator
- Mainly 2 ways of scoring response quality:
  - Precision: building, interpolated, street, city, country…
  - Confidence level

Google	geometry > location_type	ROOFTOP RANGE_INTERPOLATED	GEOMETRIC_CENTER	APPROXIMATE
Here	MatchLevel	houseNumber	street	city postalCode
Bing	entityType	Address	RoadBlock	PopulatedPlace Postcode1
TomTom	type	Point Address	Street Address Range Cross Street	Geography
Nominatim	class	building amenity shop place	highway	
	place_rank	30	26-27	14-25

Here	Relevance	0-1 (% of input matching the result)
	MatchQuality	0-1 for Street, HouseNumber, City (attribute level relevance)
	MatchType	pointAddress or interpolated
TomTom	matchConfidence	0-1
Bing	confidence	“High”, “Medium”, “Low”
	matchCode	list of “Good”, “Ambiguous”, “UpHierarchy”



Map: Ferraris (KBR)

- Concepts
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  -
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  -
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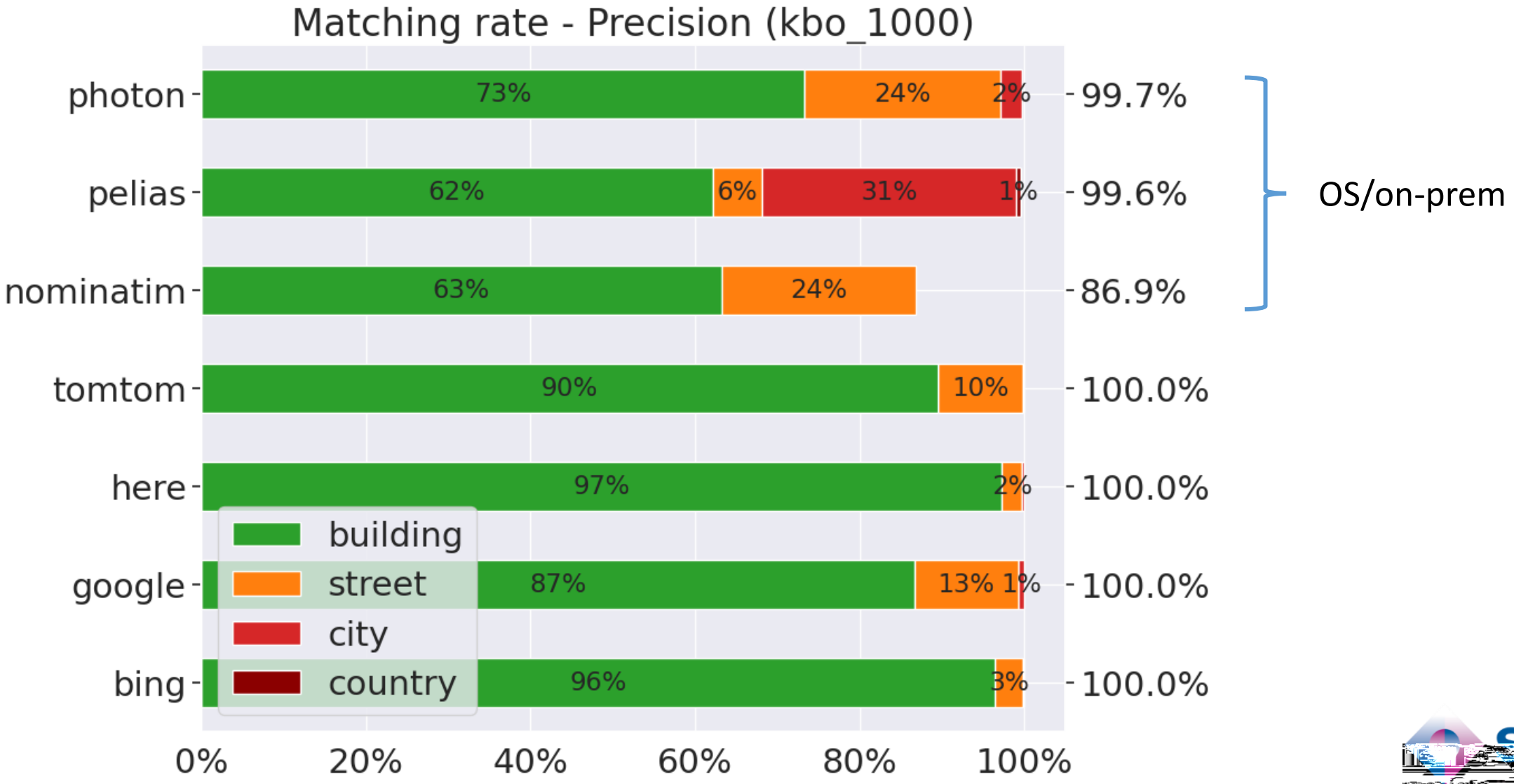
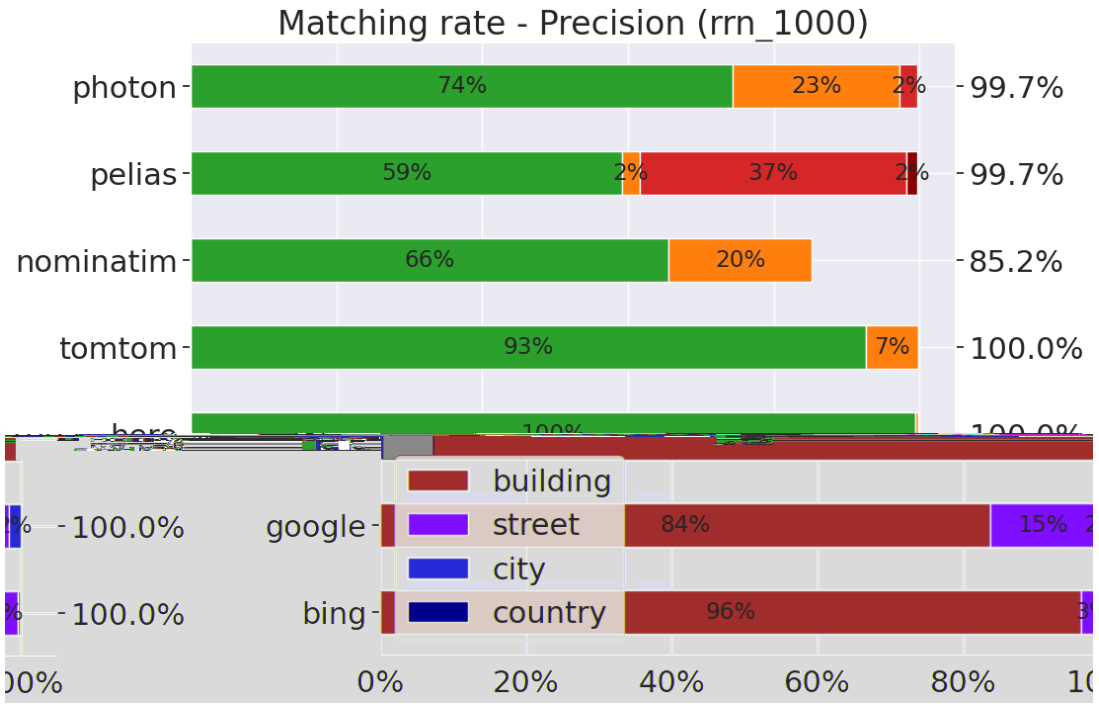
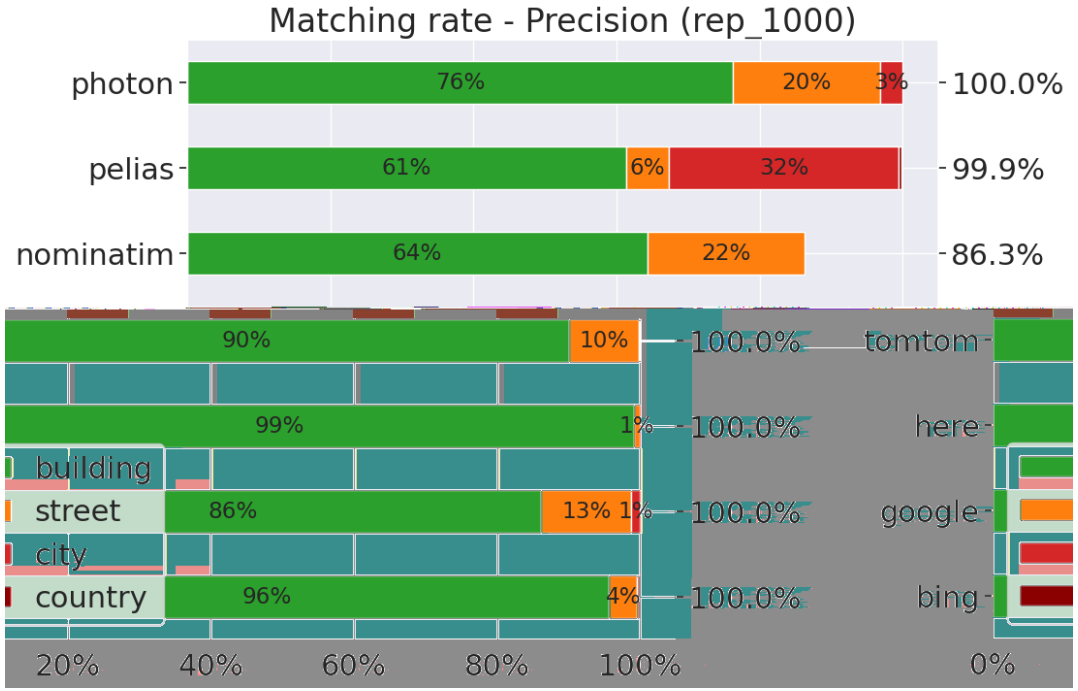
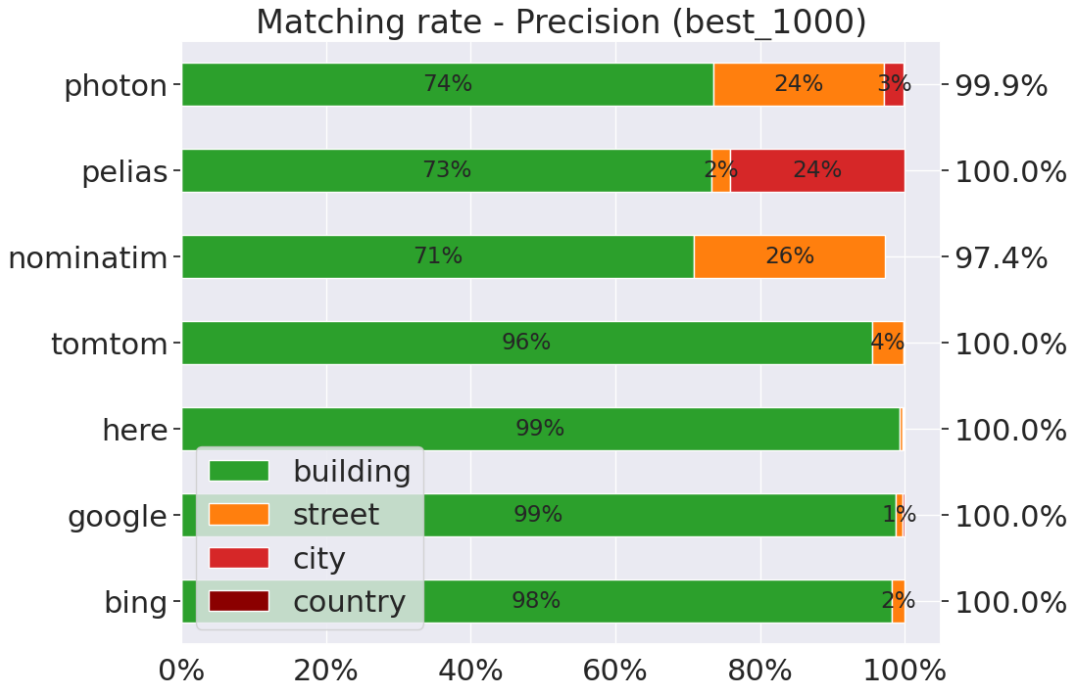


OS/on-prem

Dataset : 1 000 (Belgian) addresses from KBO OpenData





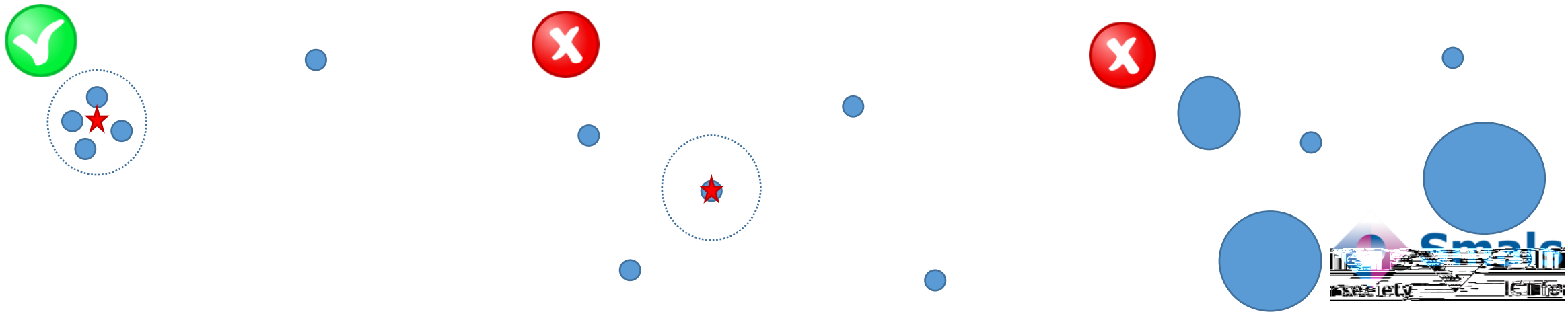


RRN: National Register (IBZ)
REP: Employers repertorium (ONSS/RSZ)
KBO: Crossroads Bank for Enterprises (SPF eco)
BeST: BestAddresses (BOSA)

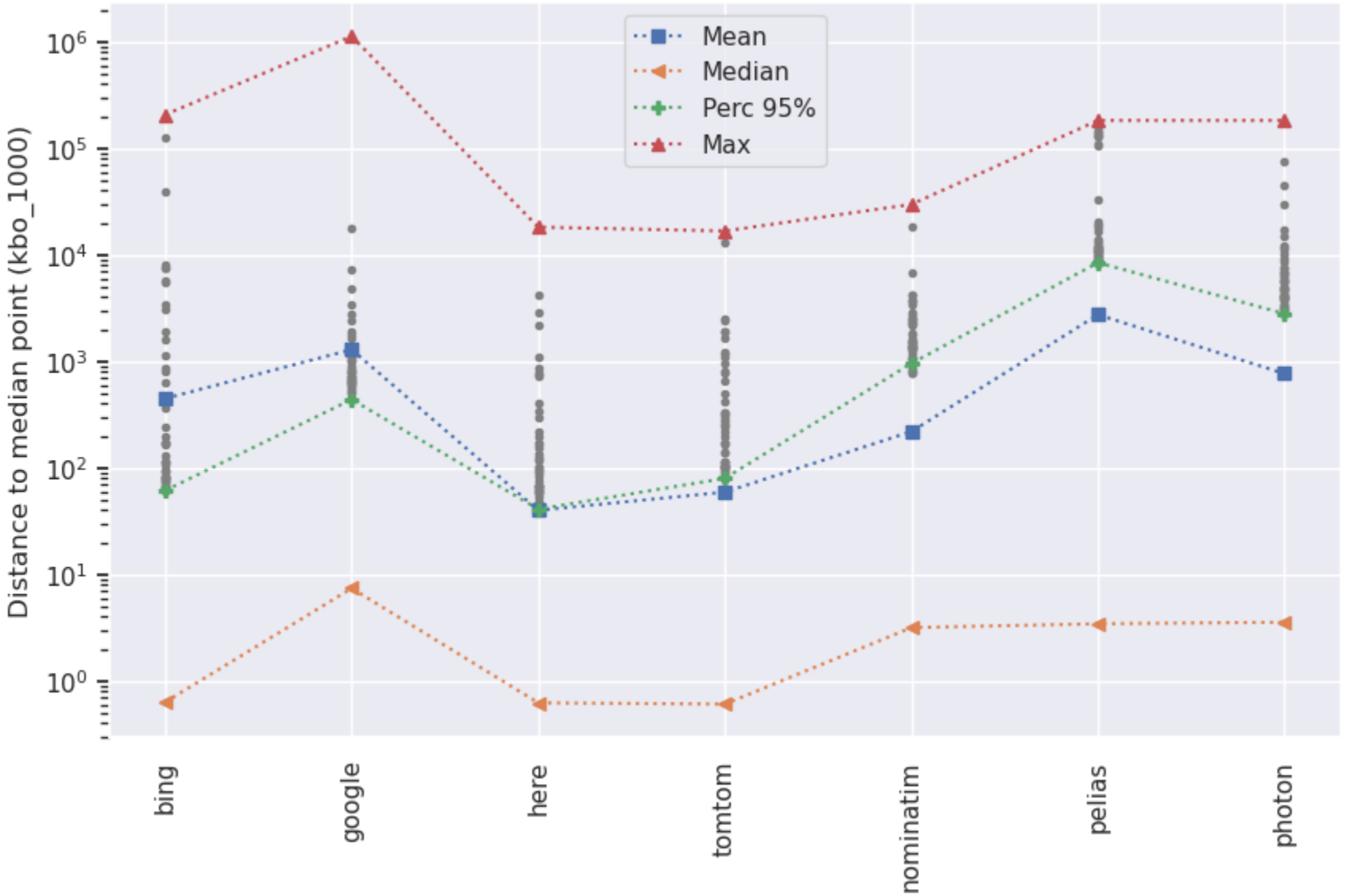
- Giving an answer does not make this answer to be correct!
- Ideal situation: testing against a reference address list. But:
  - Building such a list is complex!
  - List will be (intrinsically) biased

→ We propose a methodology based on a “majority vote”

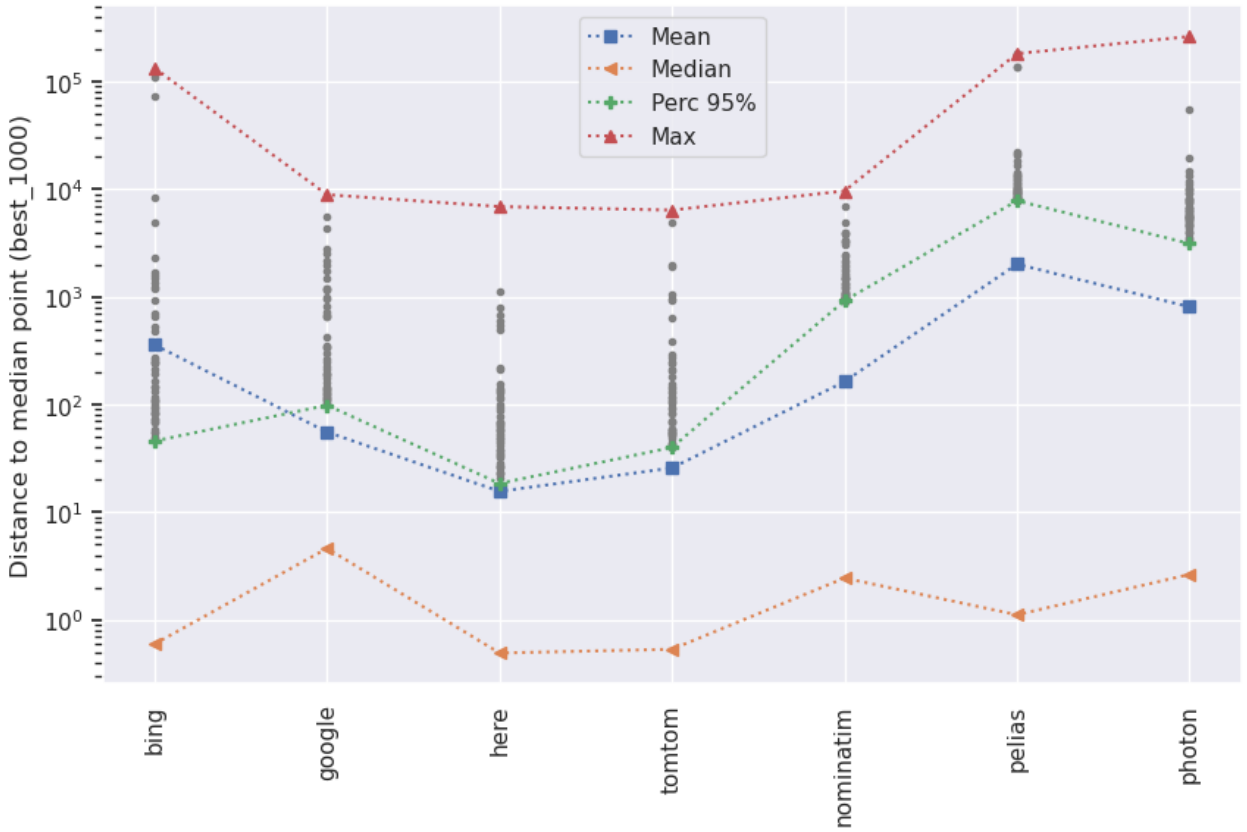
- Collect a (not too clean) address dataset → 1 000 addresses from KBO
- Send this dataset to several coders → here, bing, nominatim, google…
- Use median point for each address as reference, with some conditions:
  - Enough (precise) matches → 957 with ≥ 3/7 “building” matches
  - Enough answers close to median → 932 with ≥ 3/7 within 100 m
- Compute misc. stats about « distance to median point »

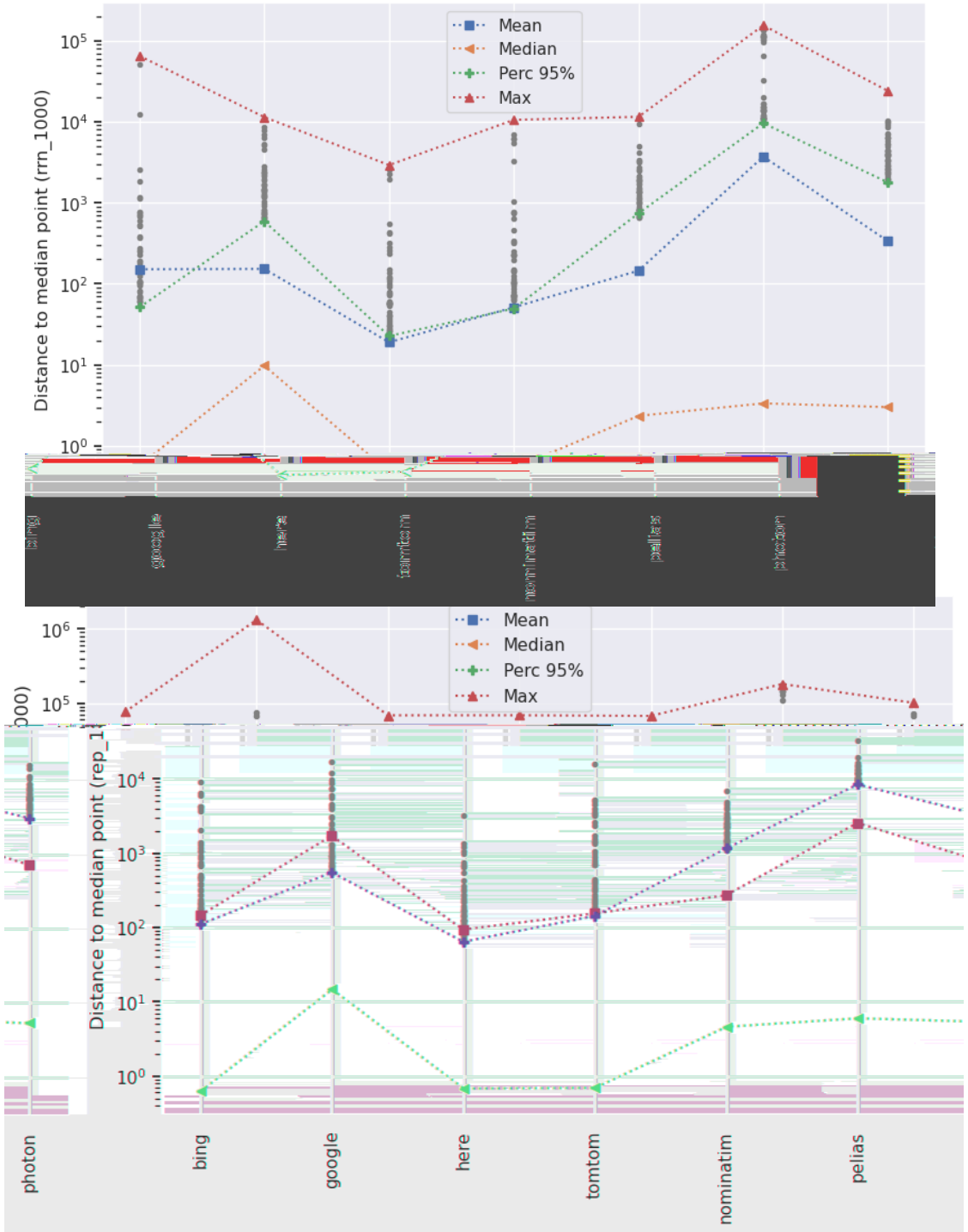


OS/on-prem

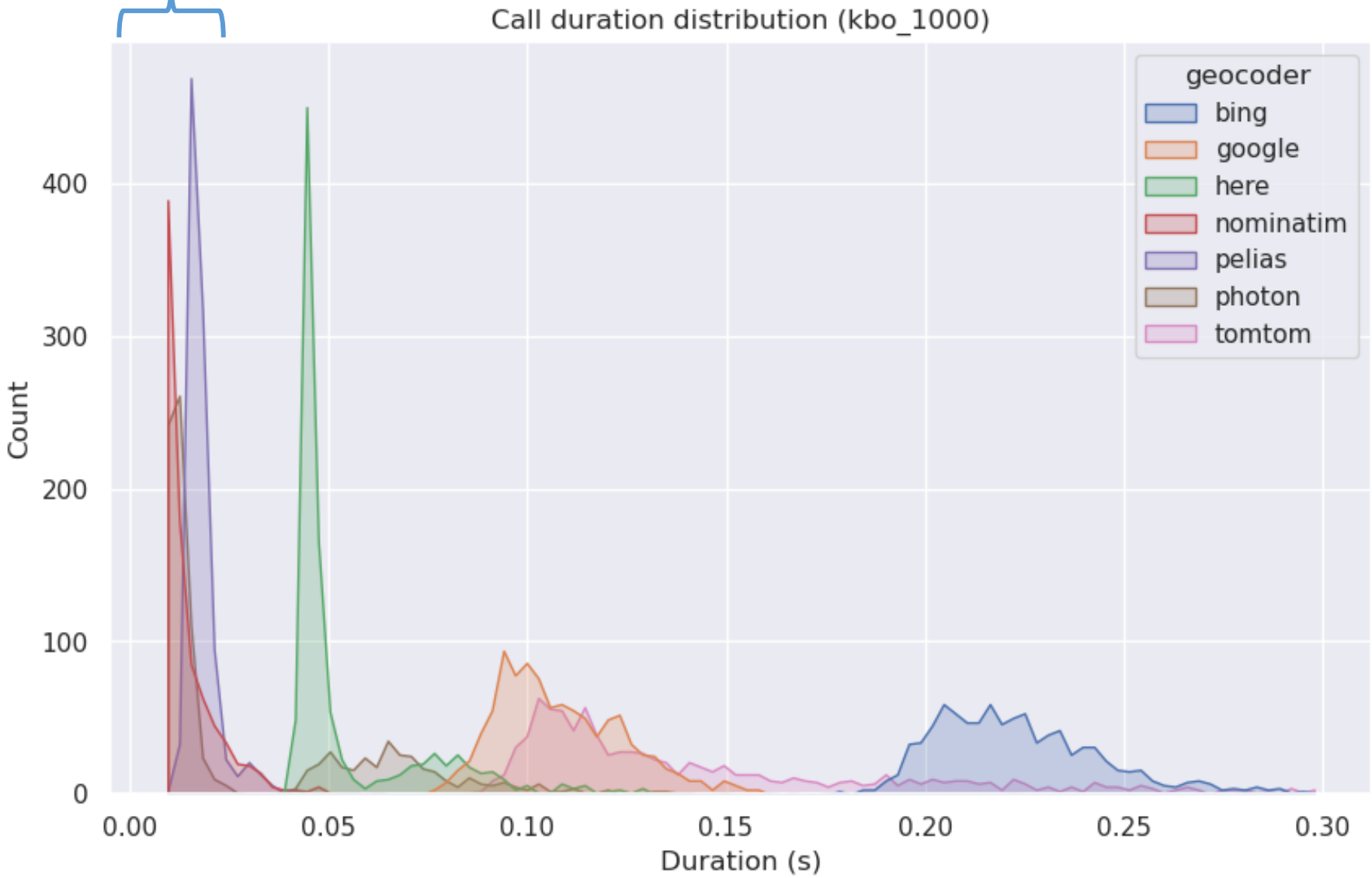


The lower the better!


Mean
Median
Perc 95%
Max
Distance to median point (best_1000)
10^0
10^1
10^2
10^3
10^4
10^5
bing
google
here
tomtom
nominatim
pelias
photon


Mean
Median
Perc 95%
Max
Distance to median point (rrn_1000)
10^0
10^1
10^2
10^3
10^4
10^5
Mean
Median
Perc 95%
Max
10^5
10^6
Distance to median point (rep_1
10^0
10^1
10^2
10^3
10^4
photon
bing
google
here
tomtom
nominatim
pelias

OS/on-prem (→ same machine!)

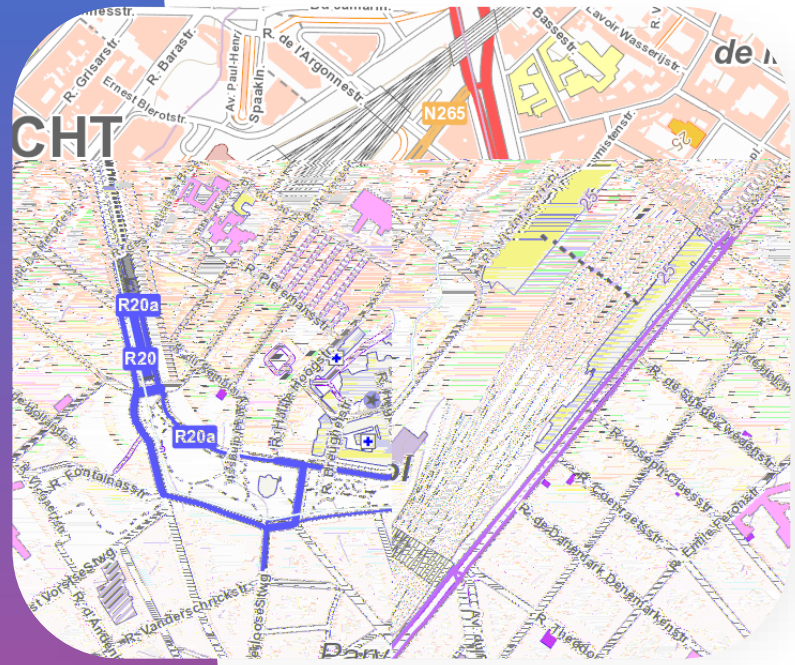


Google	40 000 /month	1 333
Here	30 000 /month	1 000
Tomtom	2 500 /day	2 500
Bing	125 000 /year	342
MapBox	100 000 /month	3 333

Google: credit card required!

Google	3.70	4.60
Here	0.53	0.66
Tomtom	0.50	0.50
Bing	Contact sales?	
MapBox	0.42	0.69

* Without contacting sales
  1$ = 0.93 €



- Concepts
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-
  -
  -
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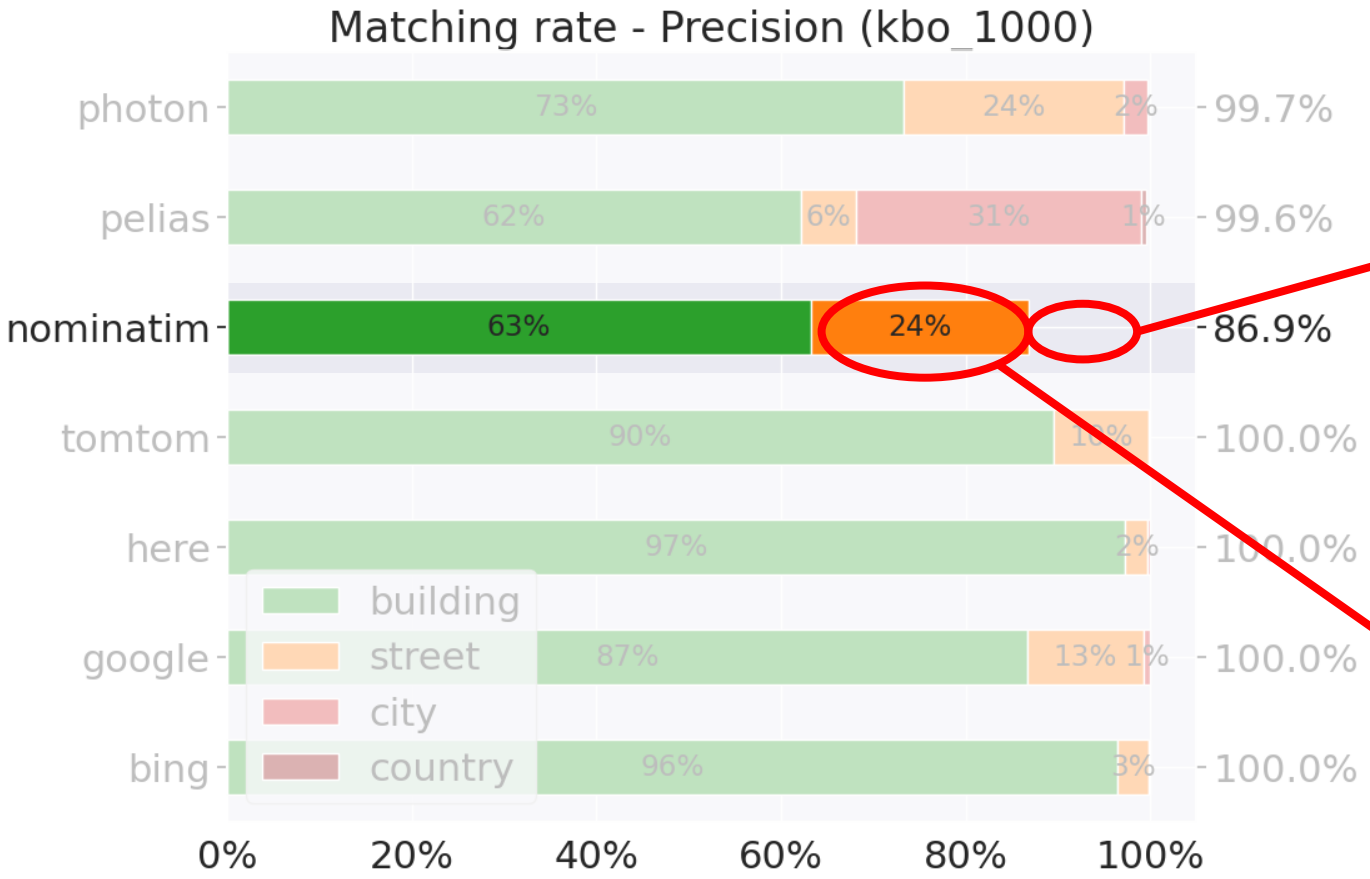
Map: geo.be (IGN-NGI)



Not very

Often → not a problem for many applications?

Weak output (~10 fields for ”street”)

- In general, does not support “small typos”
- Robustness for housenumbers:
  - Avenue Fonsny 20, 1060 Bruxelles → OK
  - Avenue Fonsny 20 bte 2, 1060 Bruxelles → No result
  - Avenue Fonsny 20/2, 1060 Bruxelles → Street level (skip 20/2)
- Robnustness with names:
  - Avenue Fonsny 20, 1060 Bruxell → No result
  - Avenue Fons 20, 1060 Bruxelles → No result
  - Aven Fonsny 20, 1060 Bruxelles → No result
- With an unknown housenumber:
  - Rue des Guildes, 22, 1000 Bruxelles → Street level (skip 22)
  - Rue Gray 96, 1040 Etterbeek → No result
  - … but : Rue Gray, 1040 Etterbeek → Street level
- Real life examples : « Avenue Fonsny, en face du 20 », « … (entrée rue X) », « Galerie Y »

https://nominatim.openstreetmap.org/search.php?q= &format=jsonv2&addressdetails=1

➔ { place_id: 48588284,

lat: "50.8358216", lon: "4.3386884", (…)

address: {

house_number: "20",

road: "Avenue Fonsny",

town: "Saint-Gilles", (…) }

road, pedestrian, footway, cycleway, path, address27, construction, hamlet, park, square

town, village, city, city_district, county

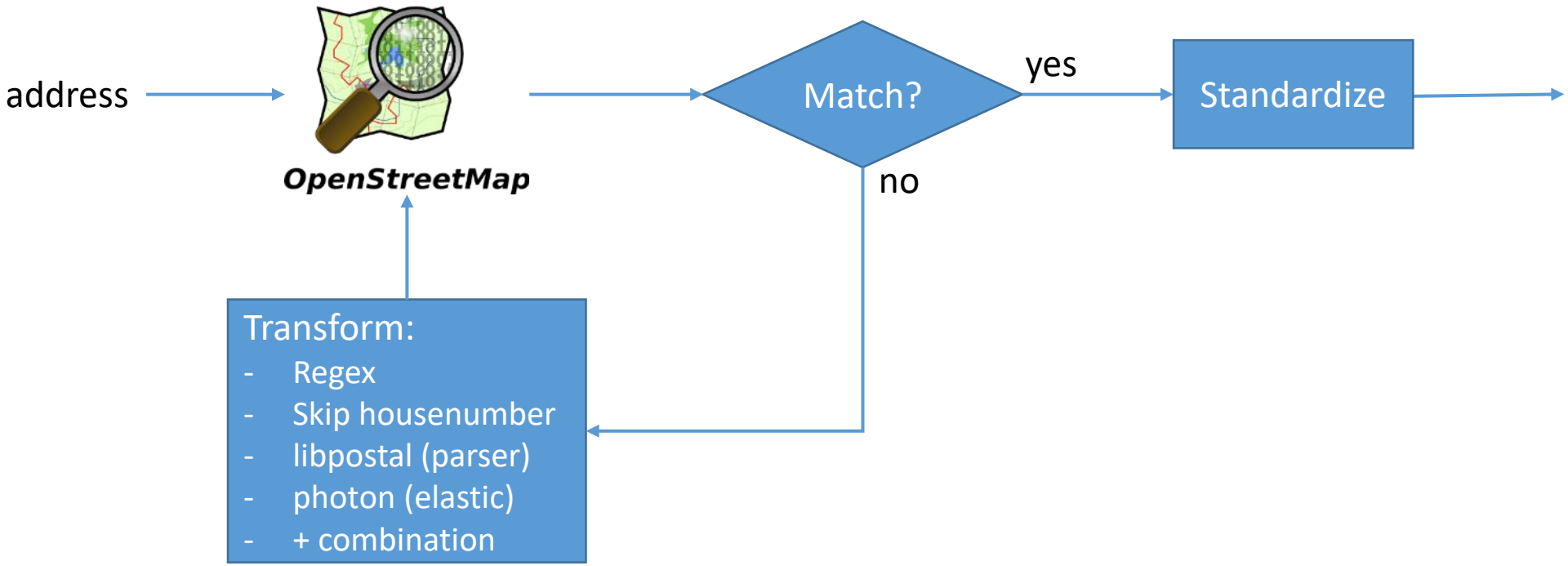
- Often, simple change allows matching:
  - Av. Fonsny → Avenue Fonsny
  - Avenue Fonsny 20 bte 2 → Avenue Fonsny 20
  - Rue Gray 96 → Rue Gray
  - Rue de Namur, Spy (Jemeppe-s-s) → Rue de Namur, Spy
- Simple tools allow to “clean” addresses:
  - Regex: “^av[\.]” ➔ “avenue ”
  - Libpostal (address parser with ML) :

“Smals, Av Fonsny 20 bte 5, 1060 St-Gilles” →

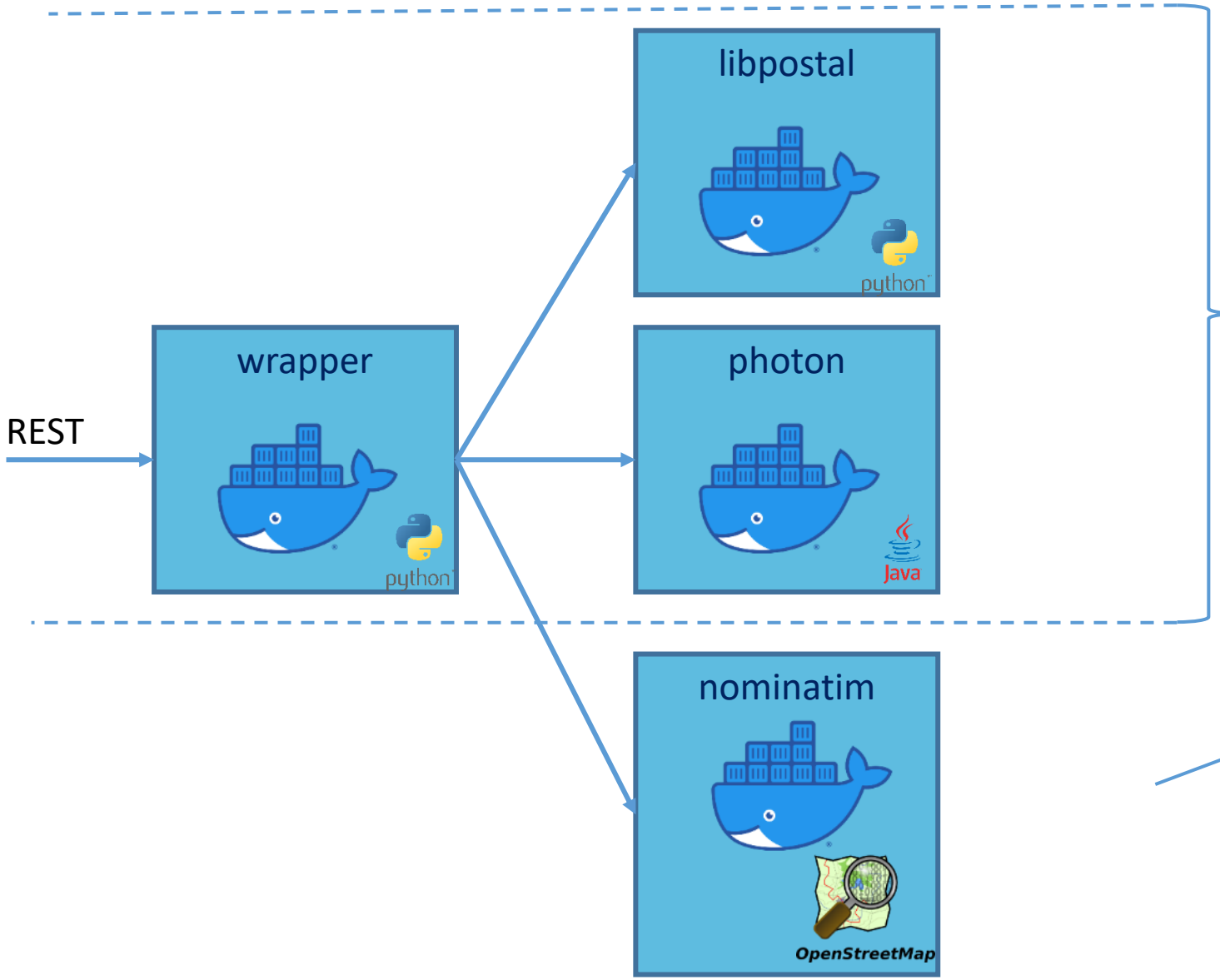
```
[('smals',       'house'),
 ('av. fonsny',  'road'),
 ('20',          'house_number'),
 ('bte 5',       'unit'),
 ('1060',        'postcode'),
 ('st-gilles',   'city')]
```

  - Photon = Nominatim+ElasticSearch

- To address the robustness and output coherence problem, we build a (REST API) « wrapper » around Nominatim
- Main idea: if Nominatim does not recognize an address, « clean it » beforehand



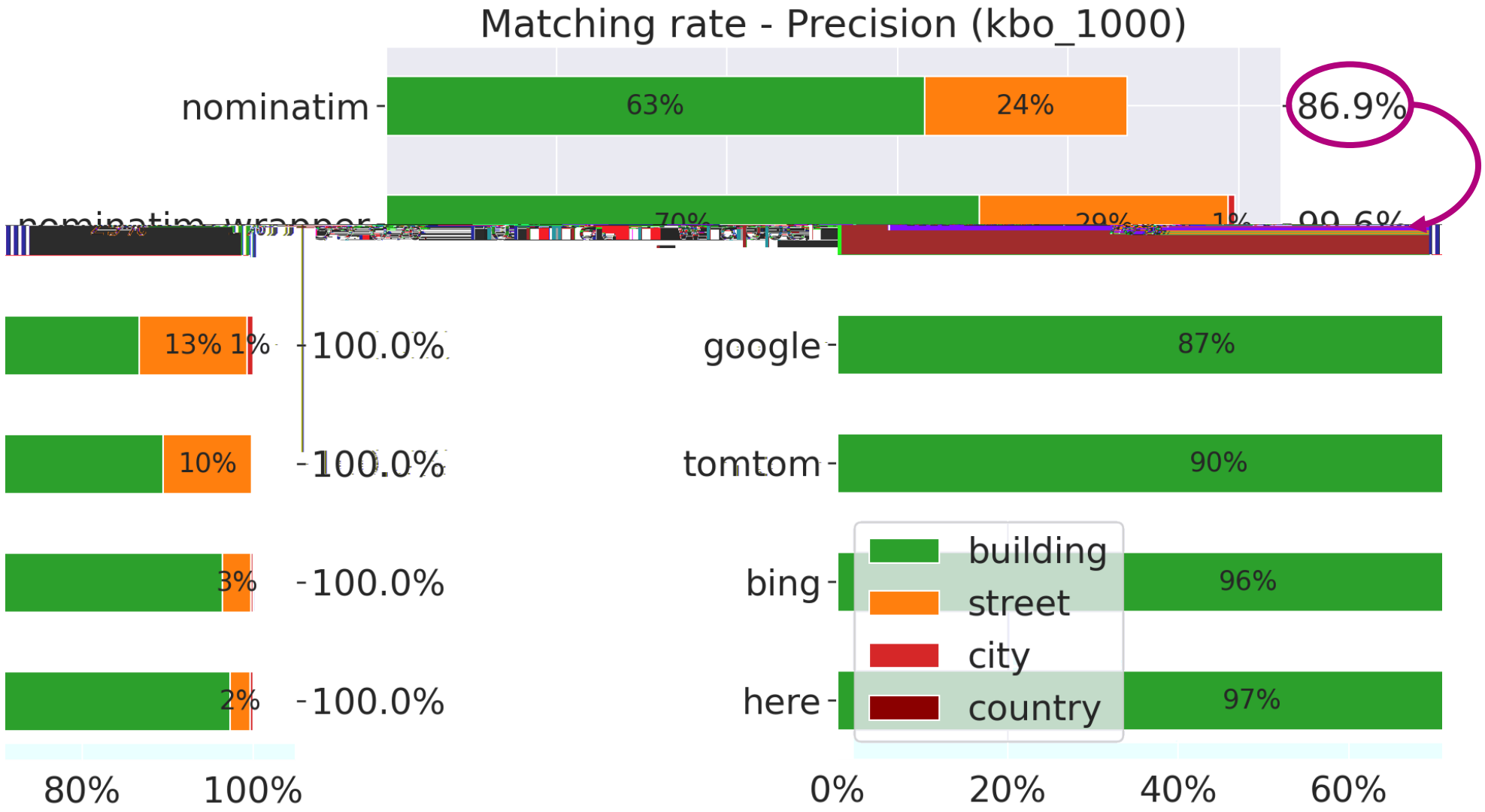
Smals
ICT for society

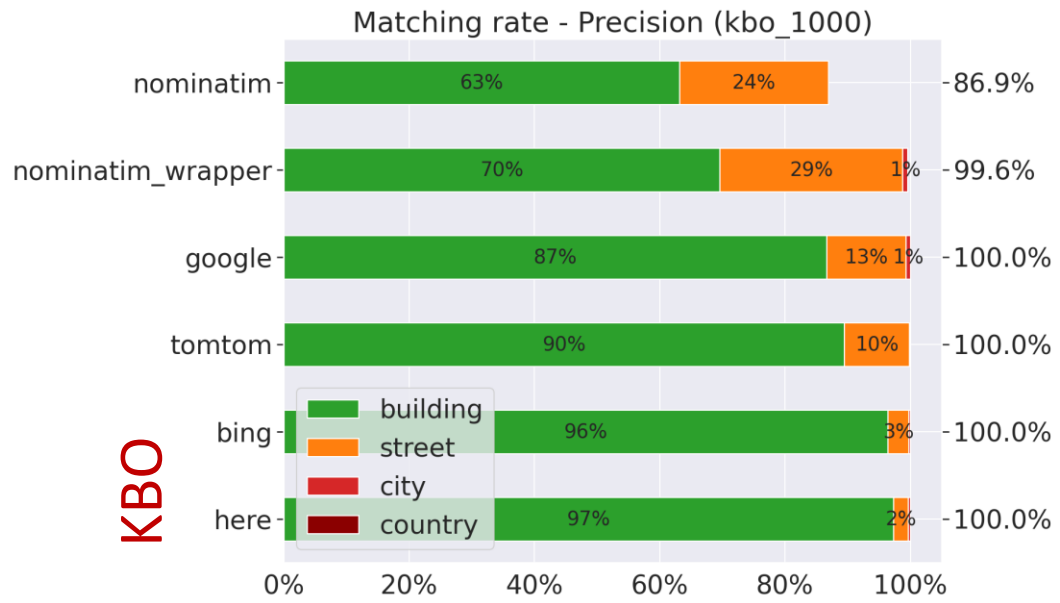


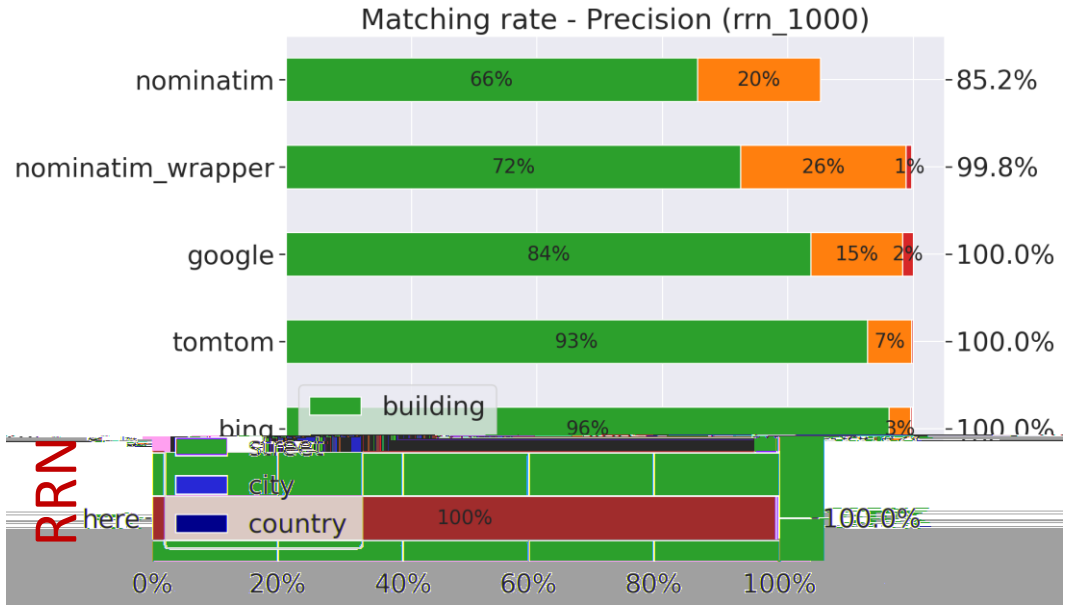
NominatimWrapper
(docker-compose)

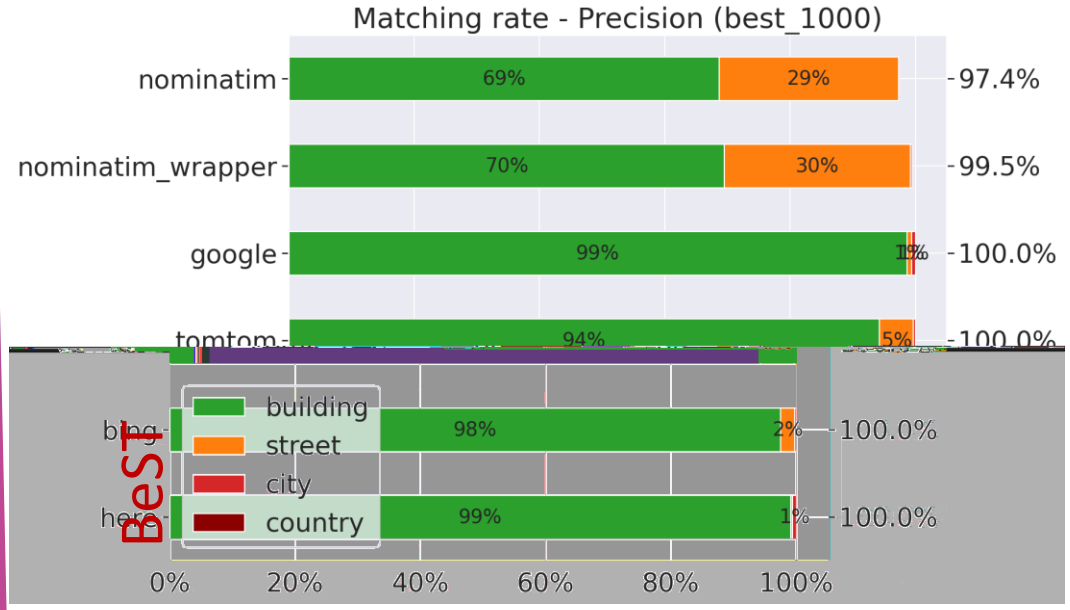
mediagis/nominatim
Options:
- Region
- Level (admin/street/address/full)

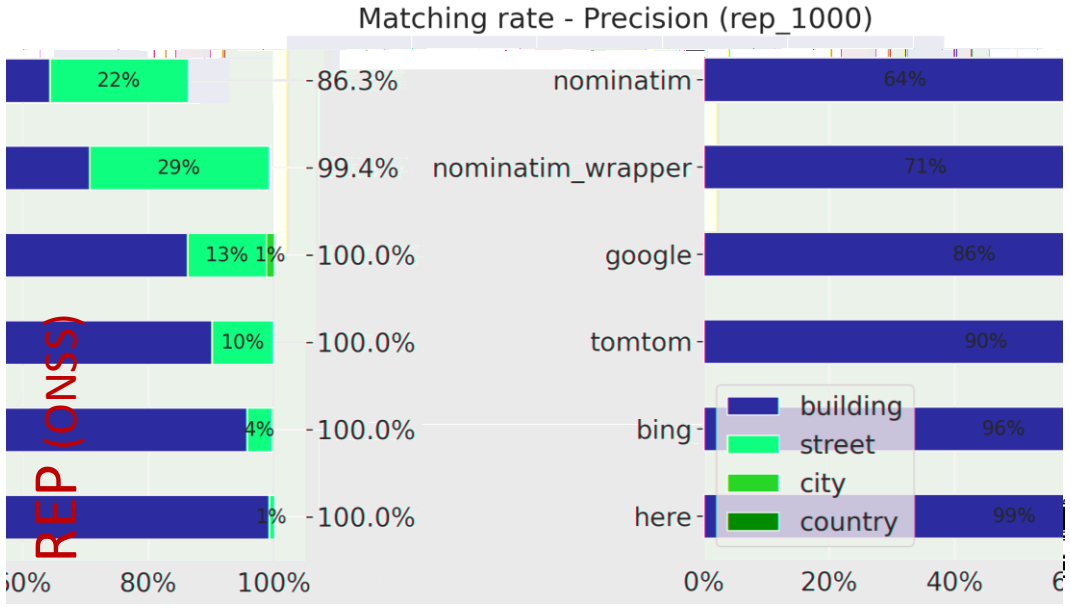
Belgium + address: ~ 30GB


Matching rate - Precision (kbo_1000)
nominatim
63%
24%
86.9%
nominatim_wrapper
70%
29%
1%
99.6%
13%
1%
100.0%
google
87%
10%
100.0%
tomtom
90%
3%
100.0%
bing
96%
2%
100.0%
here
97%
building
street
city
country
80%
100%
0%
20%
40%
60%


Matching rate - Precision (kbo_1000)
KBO
nominatim
nominatim_wrapper
google
tomtom
bing
here
63%
24%
70%
29%
1%
87%
13%
1%
90%
10%
96%
3%
97%
2%
86.9%
99.6%
100.0%
100.0%
100.0%
100.0%
building
street
city
country
0%
20%
40%
60%
80%
100%


Matching rate - Precision (rrn_1000)
RRN
nominatim
nominatim_wrapper
google
tomtom
bing
here
66%
20%
72%
26%
1%
84%
15%
2%
93%
7%
96%
100%
85.2%
99.8%
100.0%
100.0%
100.0%
building
street
city
country
0%
20%
40%
60%
80%
100%


Matching rate - Precision (best_1000)
BeST
nominatim
nominatim_wrapper
google
tomtom
bing
here
69%
29%
70%
30%
99%
94%
5%
98%
2%
99%
1%
97.4%
99.5%
100.0%
100.0%
100.0%
building
street
city
country
0%
20%
40%
60%
80%
100%


Matching rate - Precision (rep_1000)
REP (ONSS)
22%
29%
13%
1%
10%
4%
1%
86.3%
99.4%
100.0%
100.0%
100.0%
nominatim
nominatim_wrapper
google
tomtom
bing
here
64%
71%
86%
90%
96%
99%
building
street
city
country
0%
20%
40%
80%
100%

- Published as Open Source (Github). Deployement in two steps:
  - Nominatim: 1 Docker command line
  - NominatimWrapper: config + 1 Docker command line
  - One script to rule them all
- In ReUse Catalog: https://www.ict-reuse.be/fr/service/geocodage-avec-nominatim-ameliore
- References:
  - Github: https://github.com/SmalsResearch/NominatimWrapper/
  - Swagger GUI: https://nominatimwrapper.smalsrech.be/doc
  - Blog: https://www.smalsresearch.be/tag/geocoding/

- Integrated in Trillium batch
- Used for foreign addresses in a project for INASTI/RSVZ
- API integration in progress

- On-premise solution for geocoding
- Built on open-source soft/data (Nominatim, libpostal, photon)
- Match rate: ~identical to commercial solutions (from ~85 to 99,5 %)
- Precision: building or street level for ~99 % of addresses (enough for most of our cases)
- Also available for foreign countries (with a structure street/postcode/city)
- In ReUse Catalog since June 2023

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-
  -
  -
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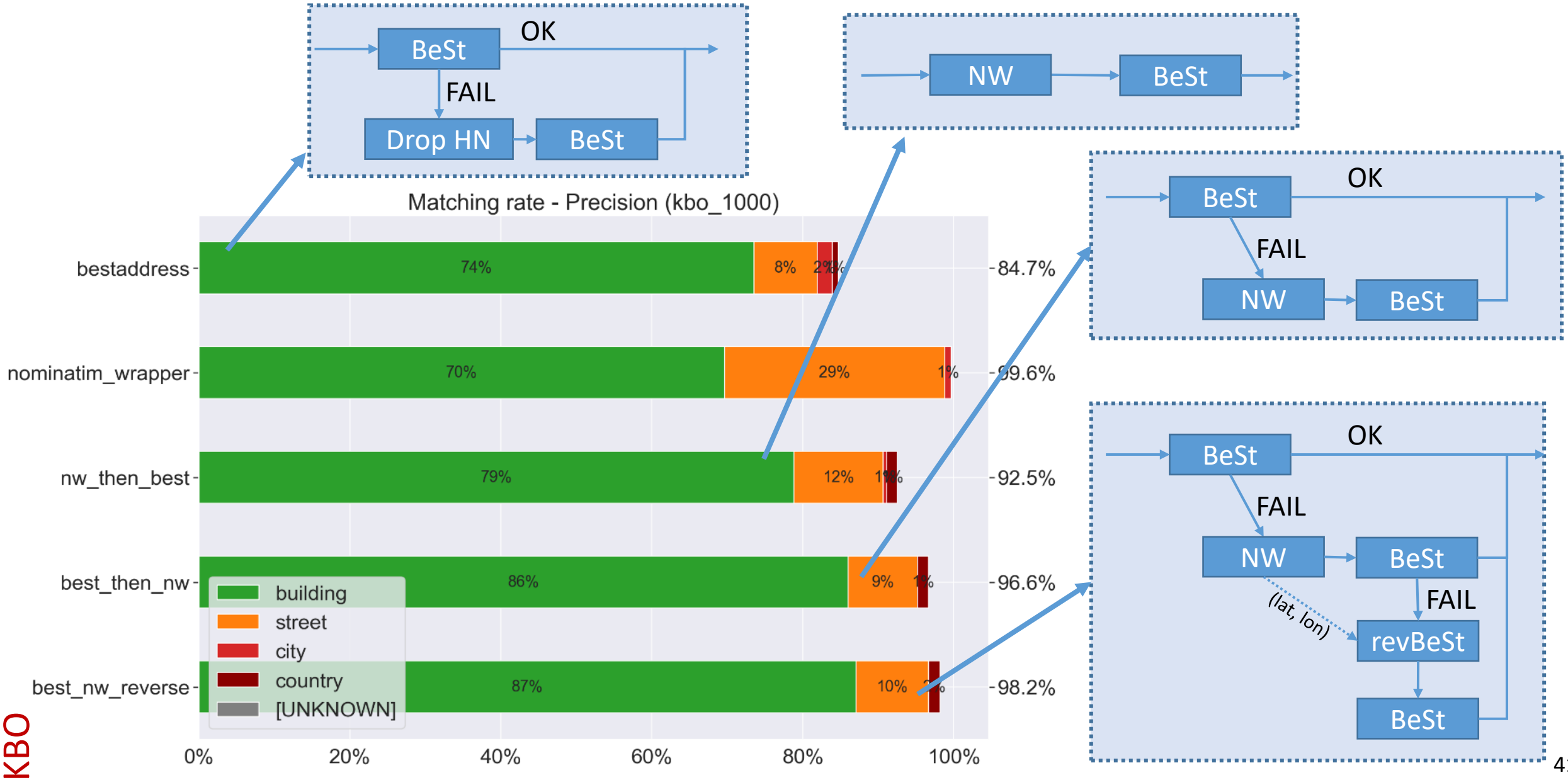
Map: bruciel.brussels

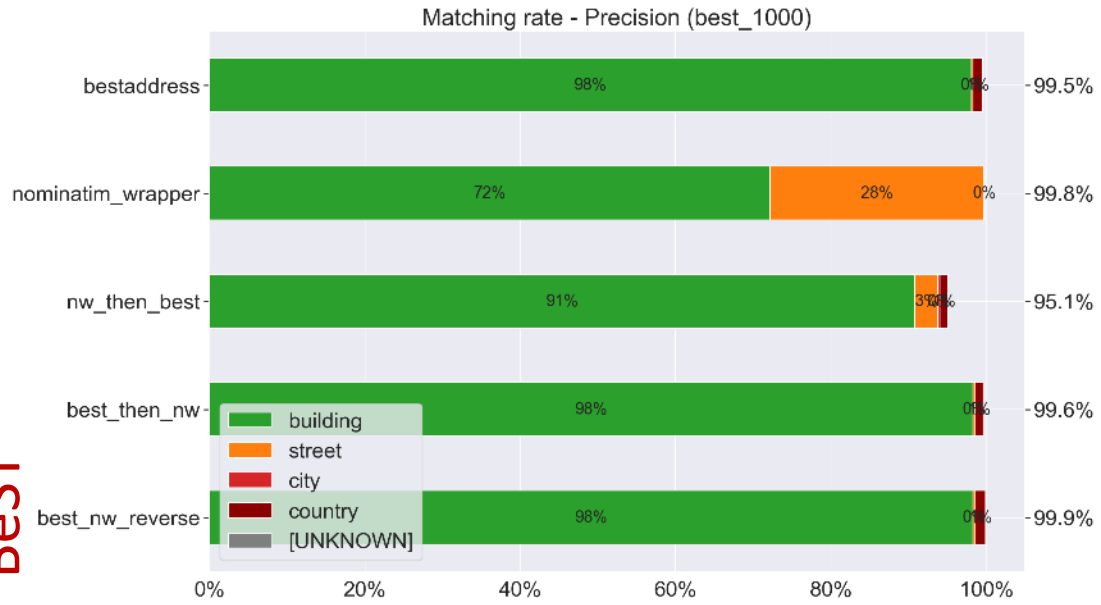
- BeSt Addresses: BOSA project providing an authentic source for Belgian addresses
- Gathering regional authentic sources: UrbiS, Adressenregister (ex CRAB), ICAR
- Each address has a (stable) id which should be used in other applications
- Can be used either through file download (public) or via API (eGov)
- Many services available (list of streets within a municipality, list of addresses within street…), but no real geocoding (no fuzzyness) → no result if query does not fully fit BeSt data (streetname, housenumber)

https://bosa.belgium.be/fr/services/best-address-services

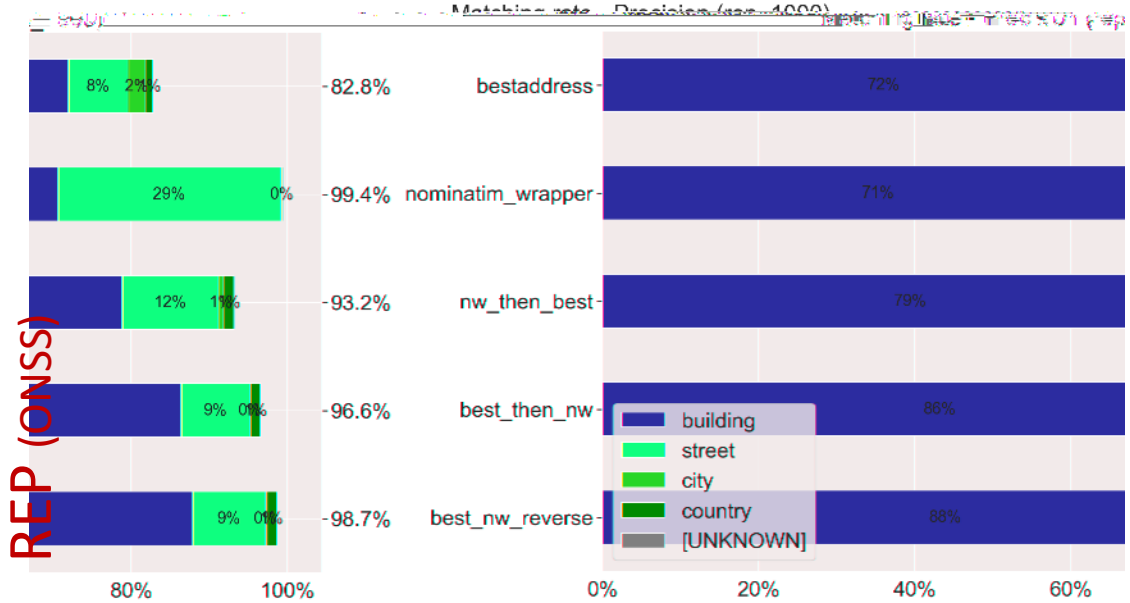

BeSt
OK
FAIL
Drop HN
BeSt
NW
BeSt
BeSt
OK
FAIL
NW
BeSt
BeSt
OK
FAIL
NW
BeSt
(lat, lon)
revBeSt
FAIL
BeSt
Matching rate - Precision (kbo_1000)
bestaddress
nominatim_wrapper
nw_then_best
best_then_nw
best_nw_reverse
74%
8%
2%
84.7%
70%
29%
1%
99.6%
79%
12%
92.5%
86%
9%
96.6%
87%
10%
98.2%
building
street
city
country
[UNKNOWN]
0%
20%
40%
60%
80%
100%

KBO

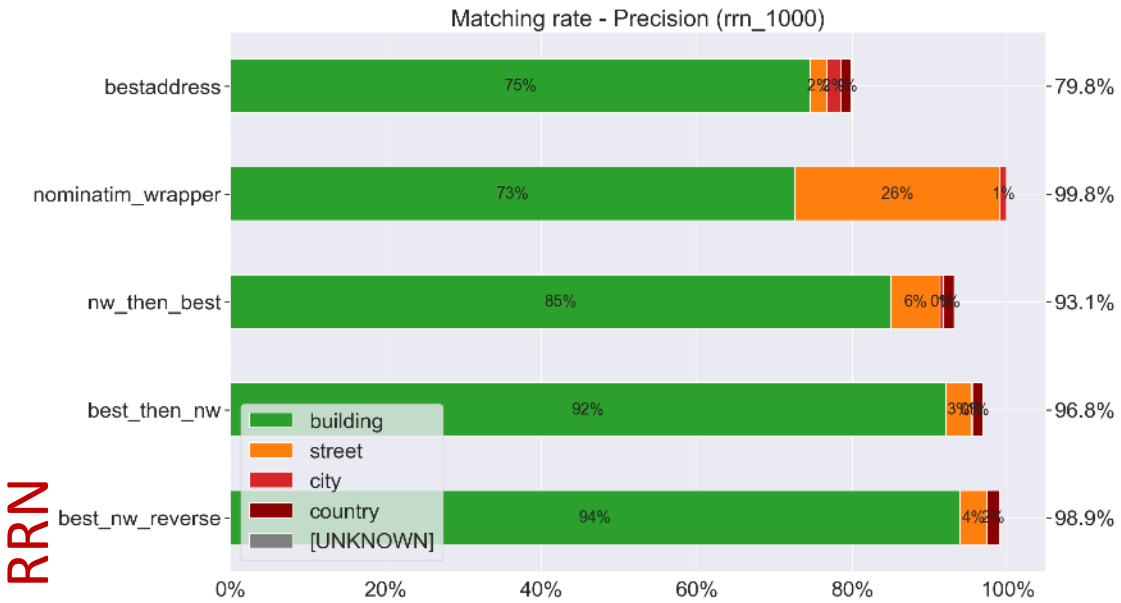
BeST

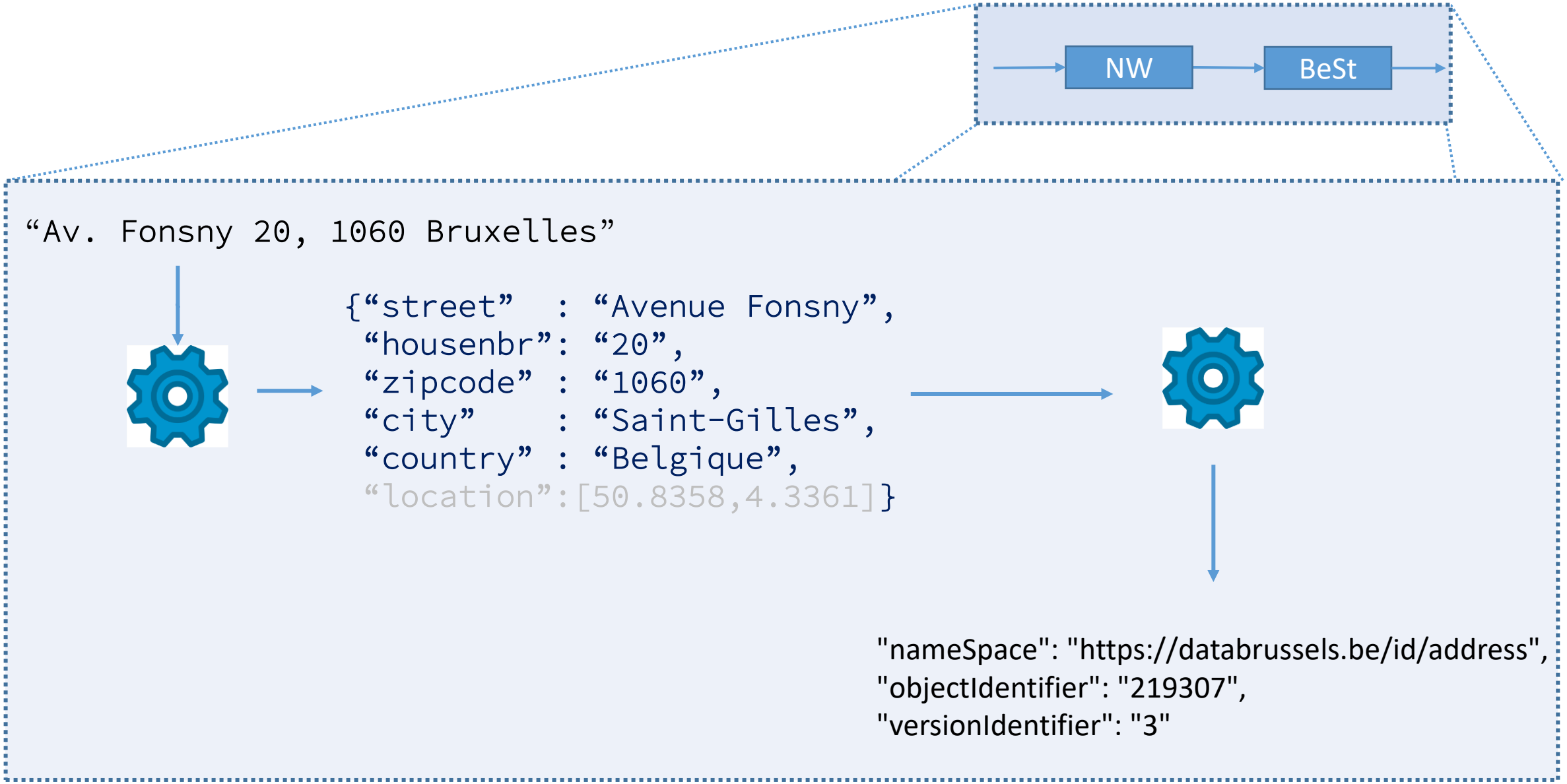


REP (ONSS)



RRN




NW
BeSt
“Av. Fonsny 20, 1060 Bruxelles”
{“street” : “Avenue Fonsny”,
“housenbr”: “20”,
“zipcode” : “1060”,
“city” : “Saint-Gilles”,
“country” : “Belgique”,
“location”:[50.8358,4.3361]}
"nameSpace": "https://databrussels.be/id/address",
"objectIdentifier": "219307",
"versionIdentifier": "3"

- Allow to add the « address cleansing » part to BeSt API
- This is not implemented in NominatimWrapper!
- It was just tested in a « lab » environment as a PoC
- With a script with a few dozen of Python lines

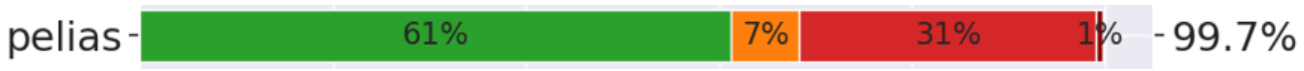
- Concepts
- Evaluation
- Nominatim based solution
- BestAddress+Nominatim based solution
-
  -
  -
- Conclusion

Map: cartesius.be (KBR)

- Open source: https://github.com/pelias/docker (projects > belgium)

- Data-source problems:
  - Based on OpenAddresses.io version of BestAddress CSV files (https://batch.openaddresses.io/), but due to some incompatibility, not updated since Feb 2021 (work in progress)
  - Pelias still uses an old OpenAddresses dataflow, deprecated mid-2021

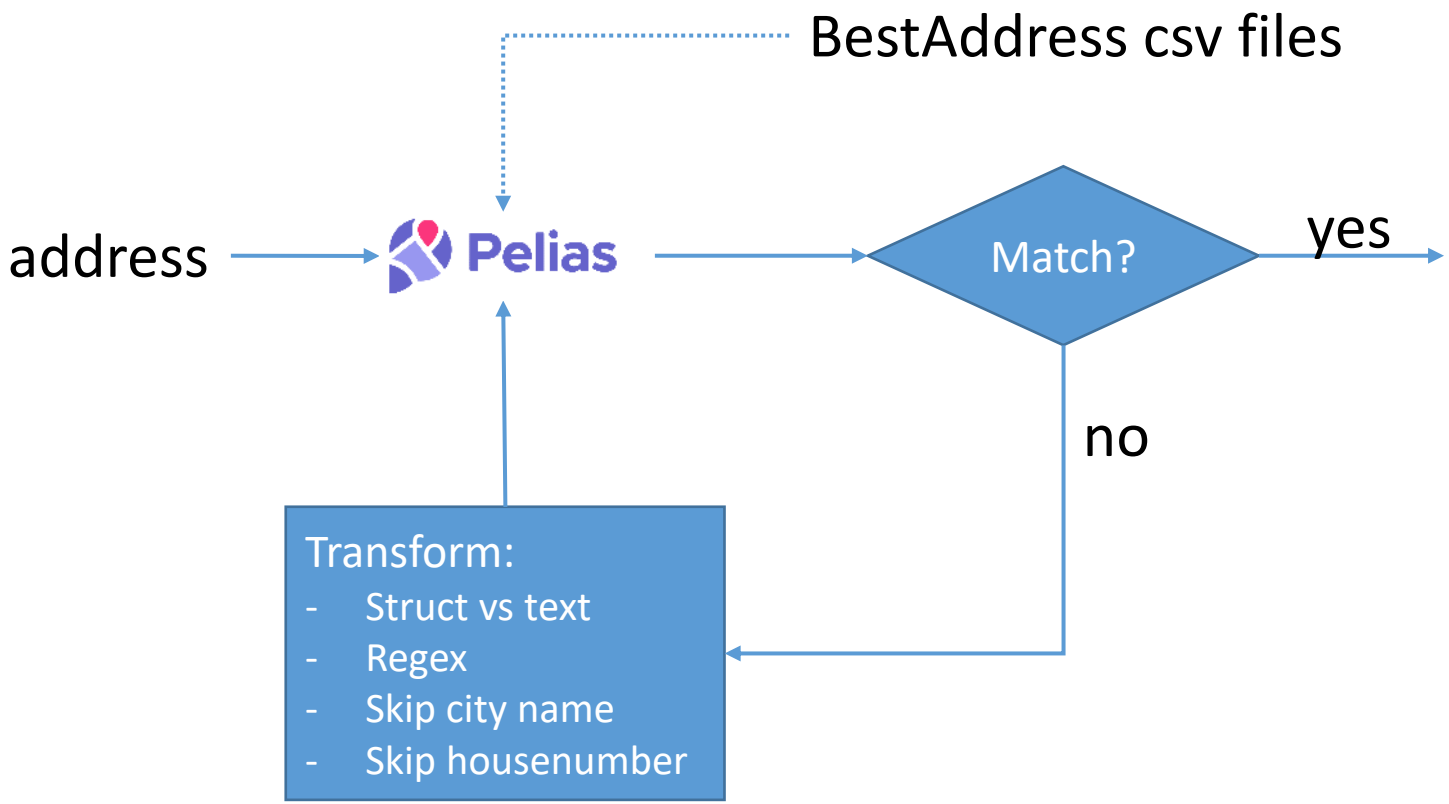
- Robustness problem:



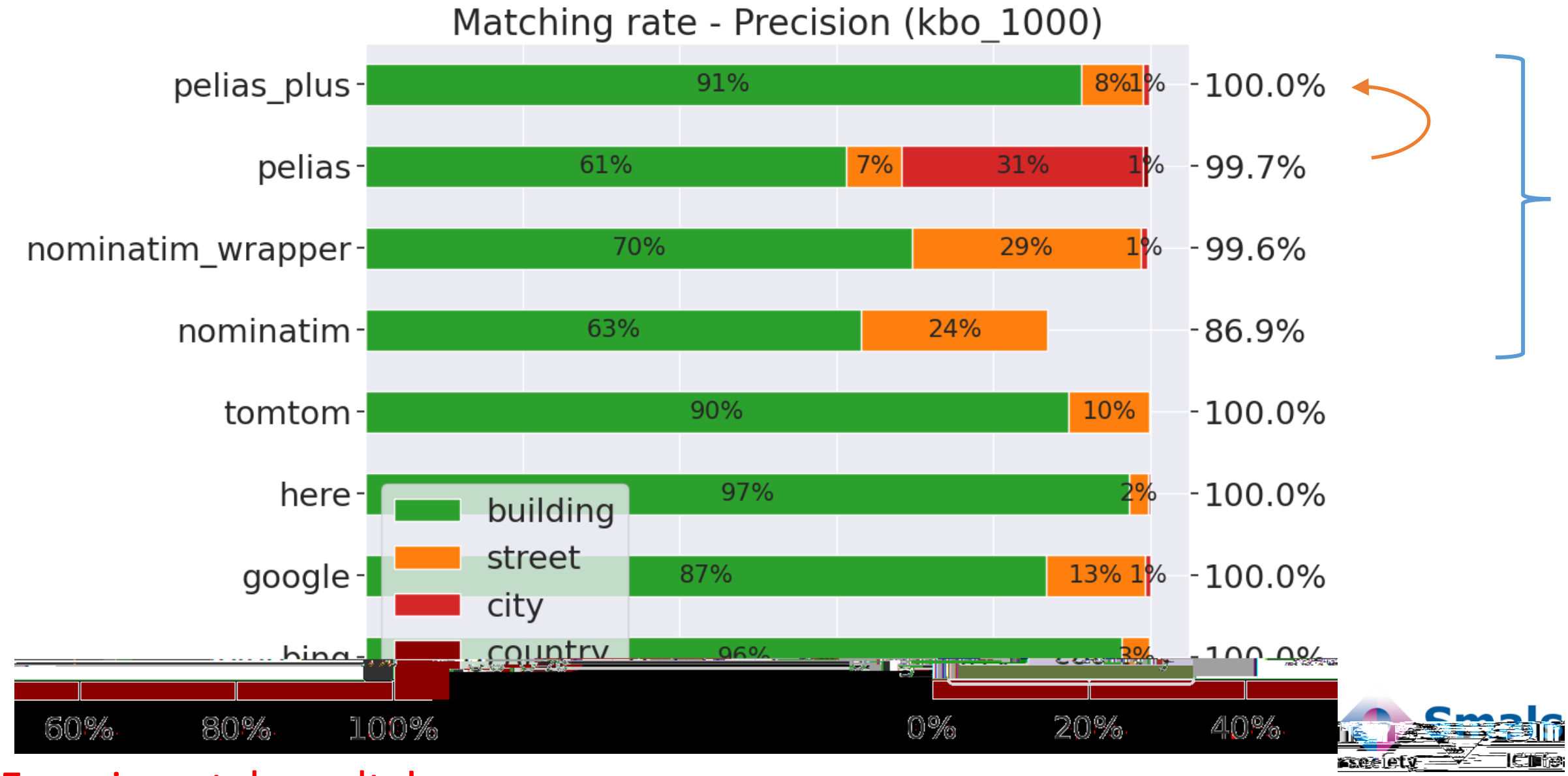
  - If structured version doesn't work, sometimes unstructured version does (and vice-versa)
  - If none works, some simple transformations often allow matching:
    - {"postalcode": 1160, "locality": "Auderghem"} → {"postalcode": 1160}
    - Cleansing text, removing parenthesis in street, non-digits in housenumber…

- Ongoing project (NGI , Bosa, Crisis Center, Smals) to address those problems

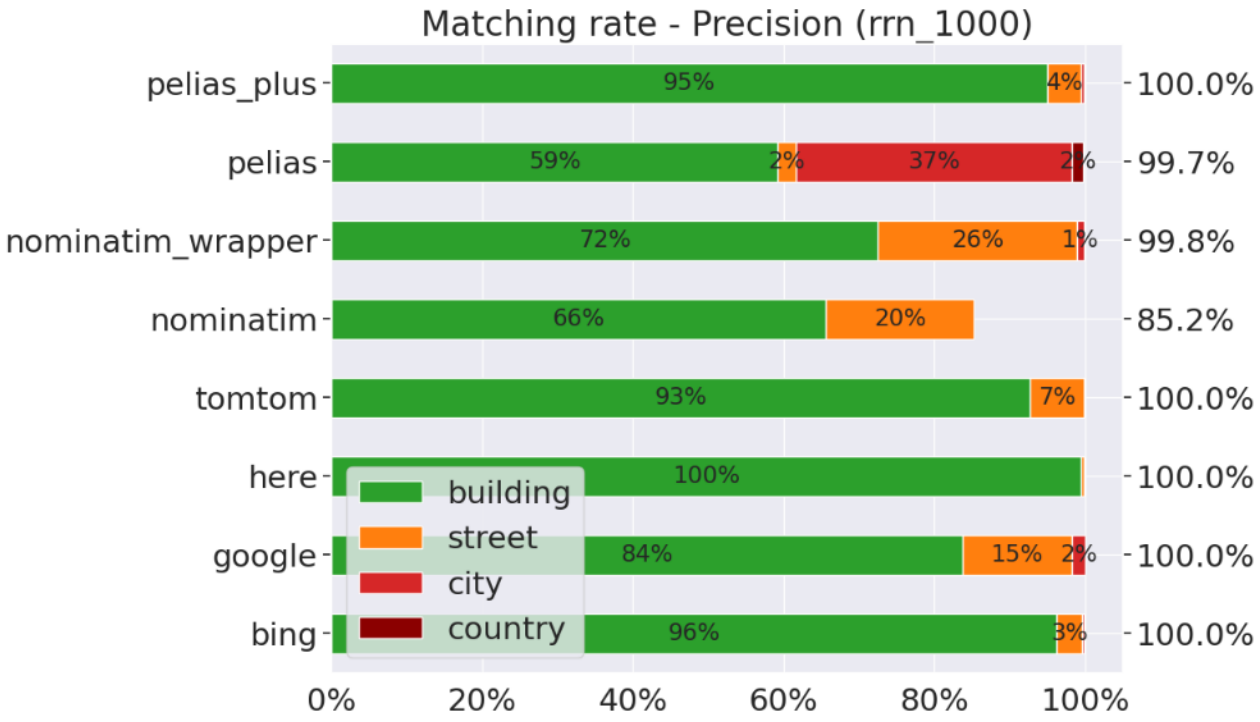
NGI Nationaal Geografisch Instituut
IGN Institut Géographique National
Centre de crise National
SPF Stratégie & Appui

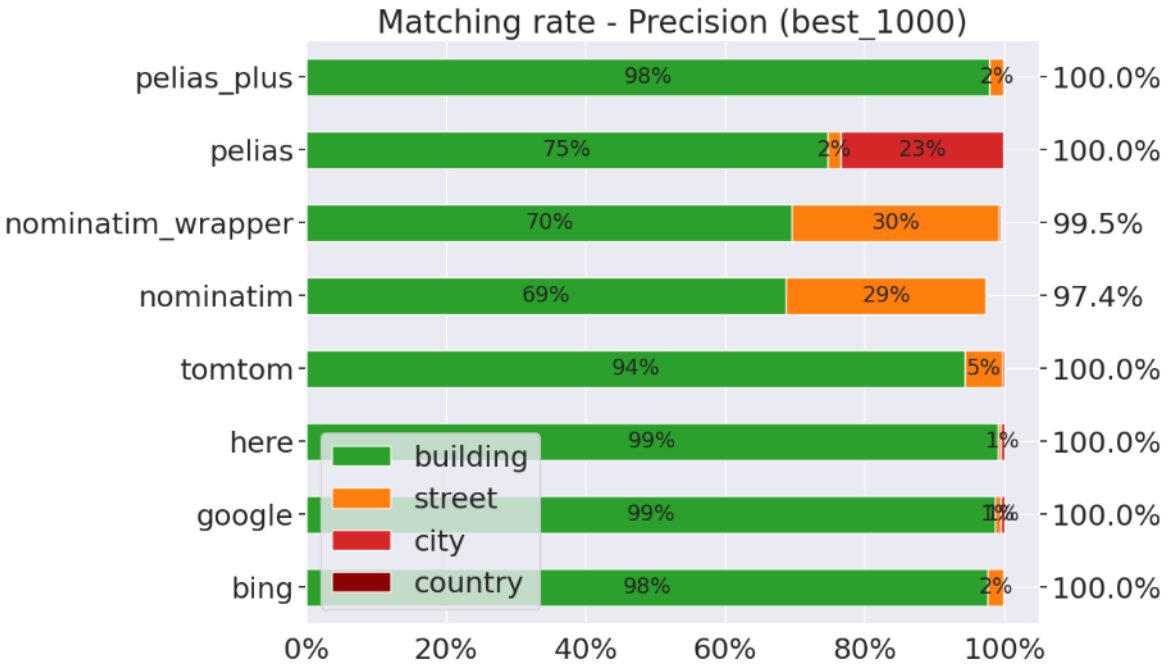


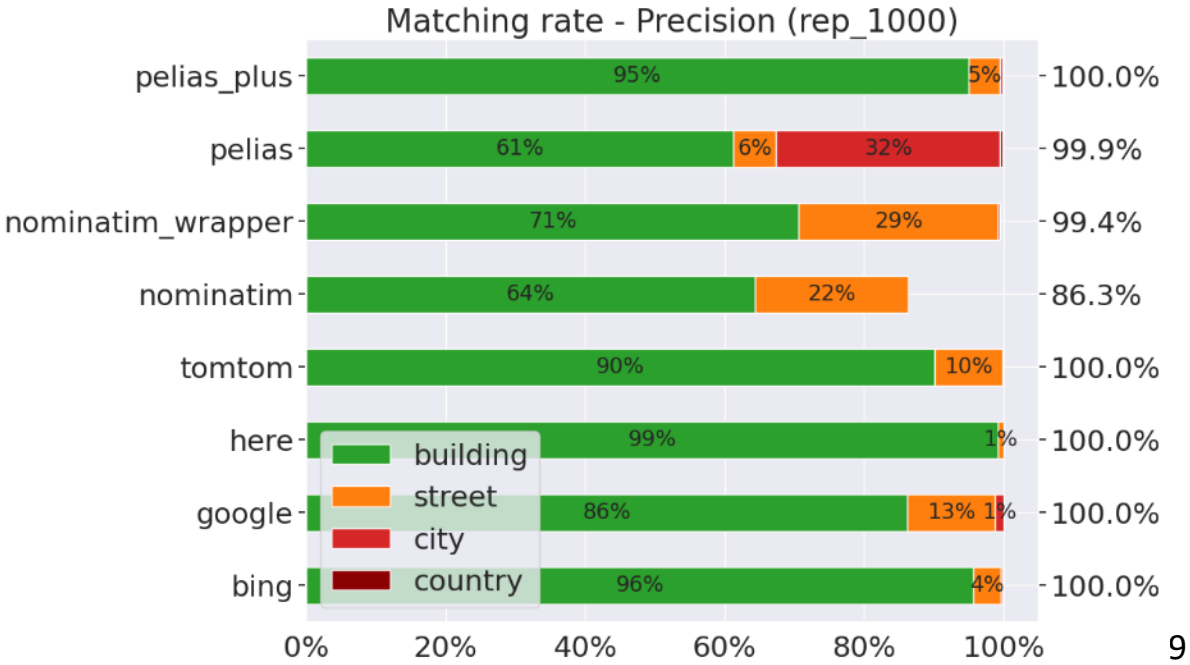
- Very early stage!
- Based on a new dataflow from BestAddress, by-passing OpenAddresses.io
- Same « transformer » logic as NominatimWrapper
- If housenumber not found:
  - Often close number is known
  - Example: “10” KO, but “10 A” or “8” and “12” OK → interpolation!
- Input data flow to be improved (e.g., municipality names + part of municipality)



Experimental results!

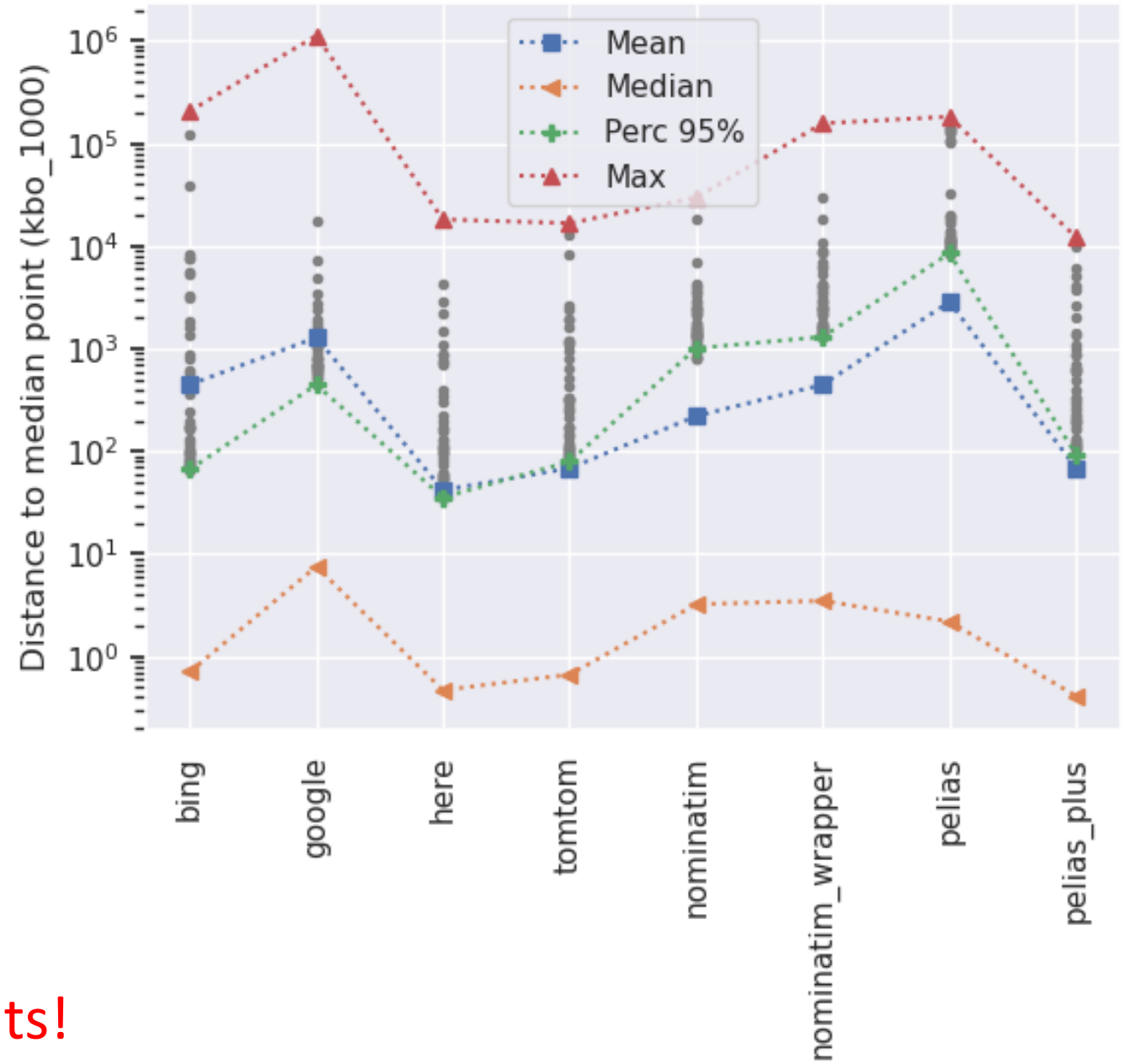






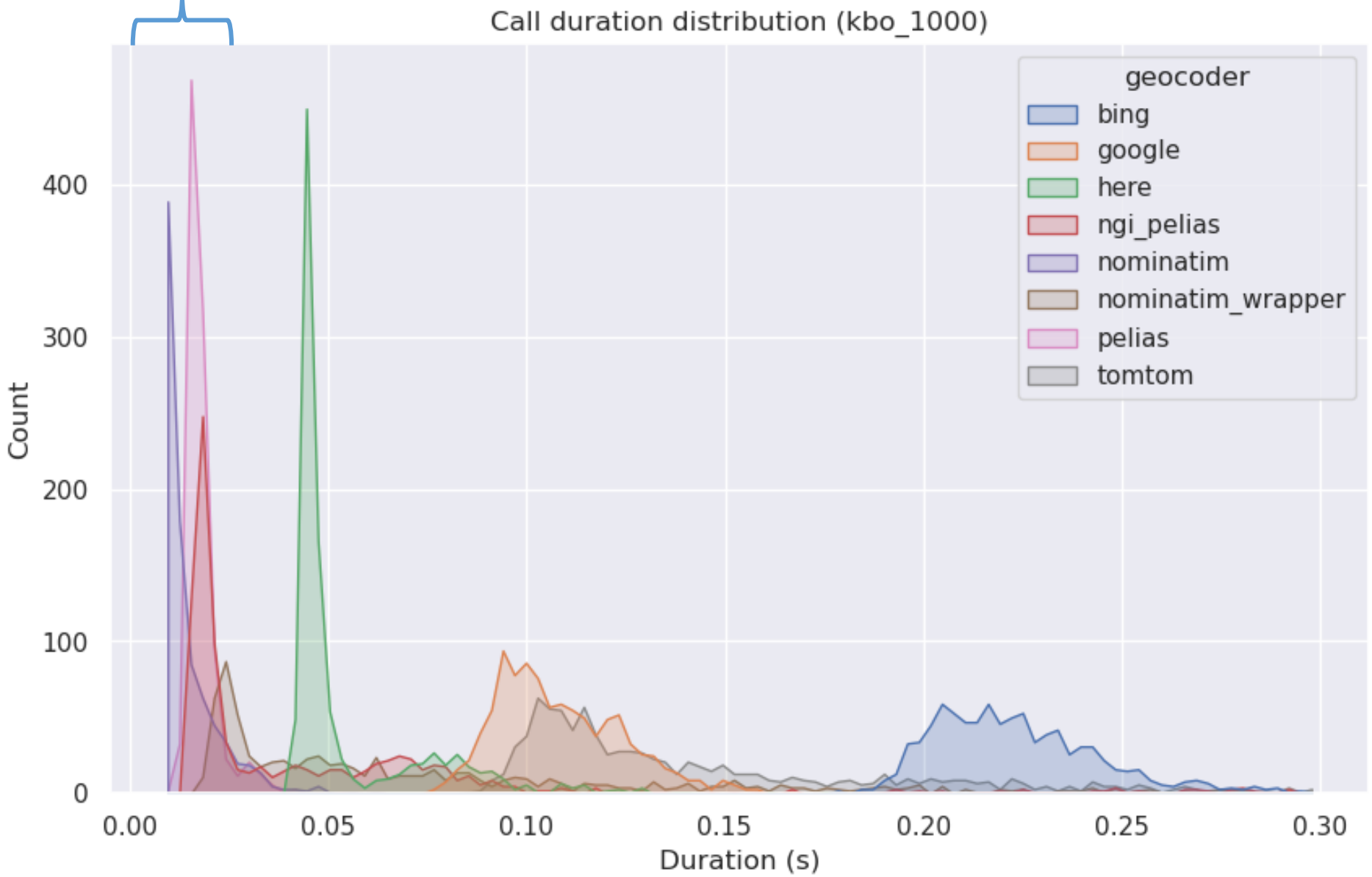
Experimental results!

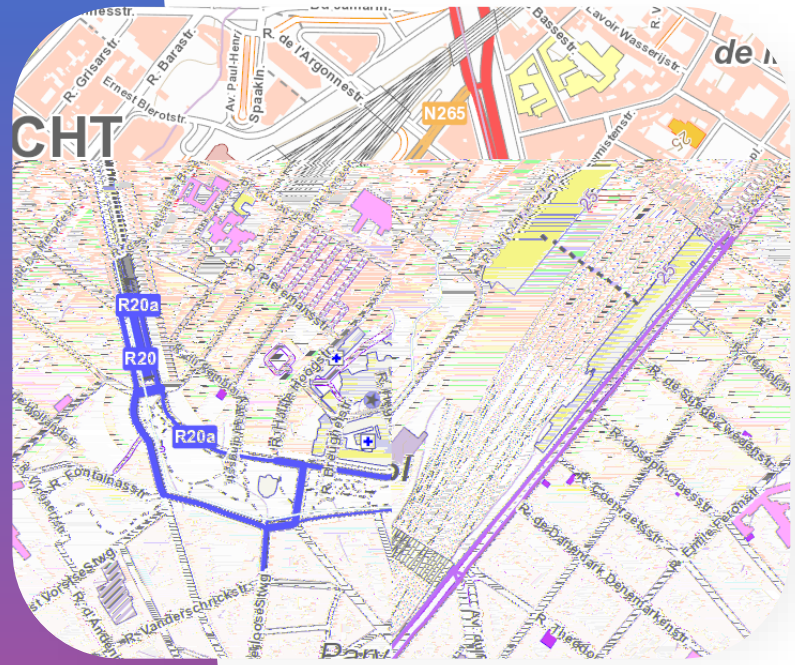
OS/on-prem



Experimental results!

OS/on-prem (→ same machine!)





- Concepts
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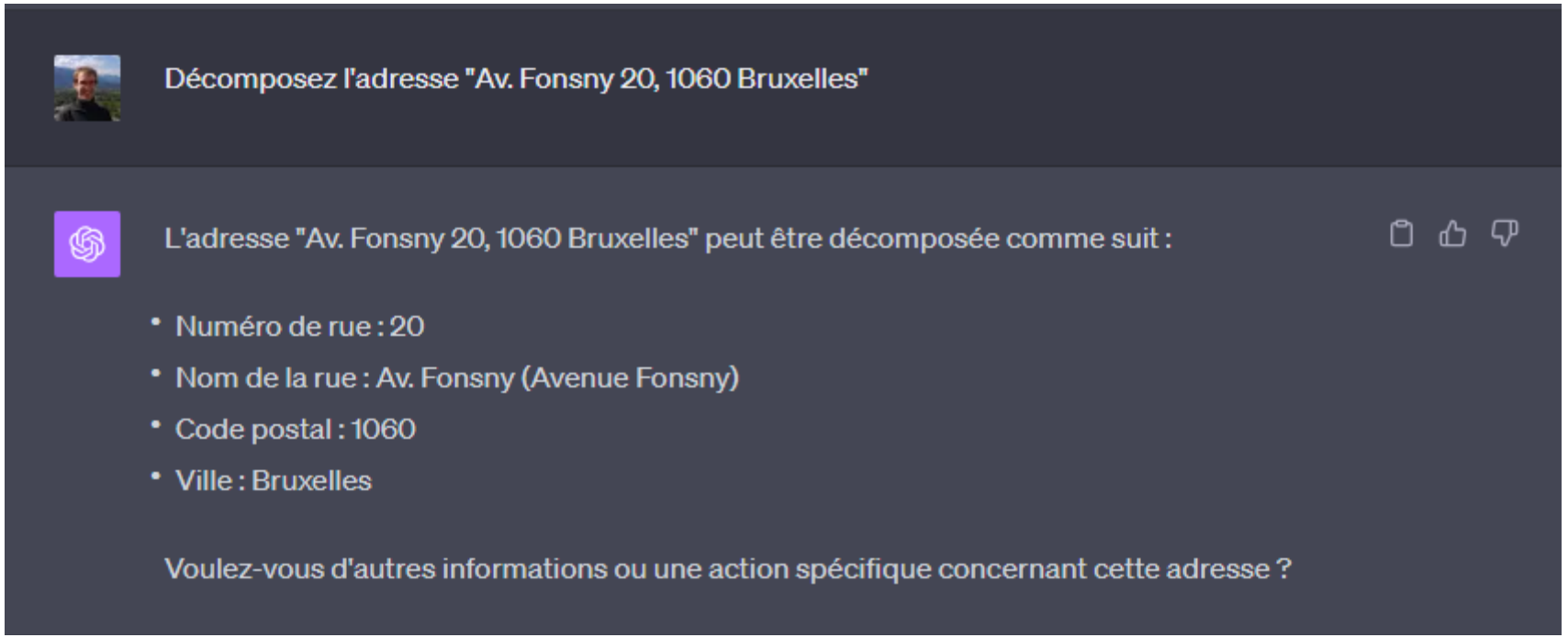
- Pelias based solution
-

Map: geo.be (IGN-NGI)

- To be also considered: external (large) company providing GIS solutions (ESRI, IBM…)
- Additional overhead to test/evaluate them
- Worthy for only geocoding?
- Perhaps useful if an SLA needs to be provided

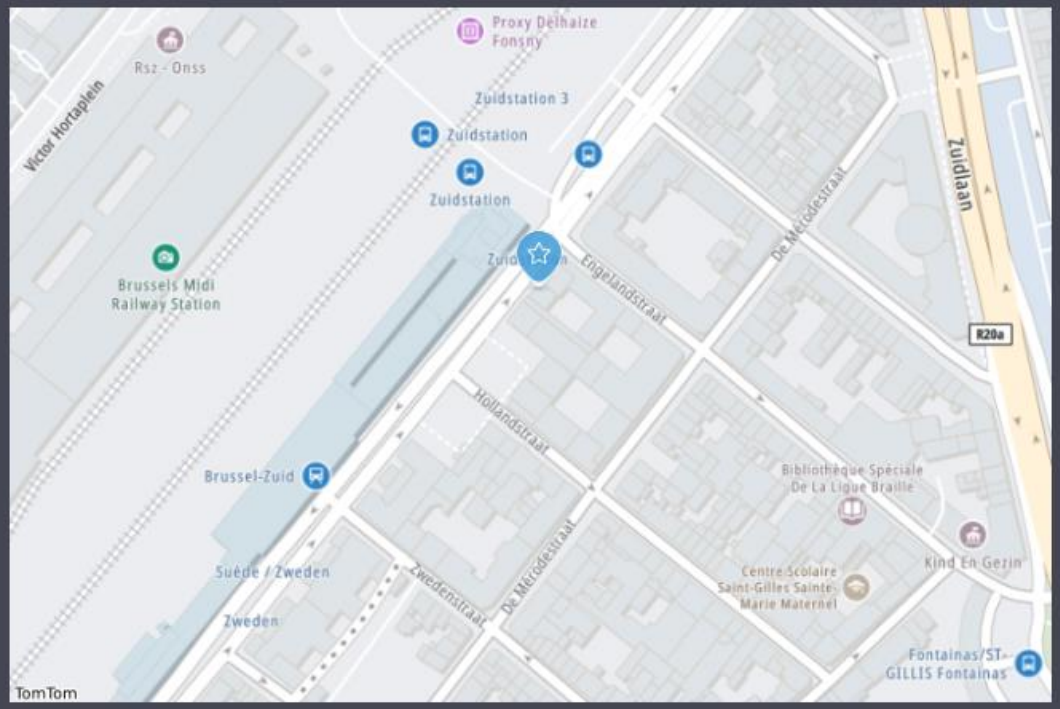

Décomposez l'adresse "Av. Fonsny 20, 1060 Bruxelles"
L'adresse "Av. Fonsny 20, 1060 Bruxelles" peut être décomposée comme suit :
• Numéro de rue : 20
• Nom de la rue : Av. Fonsny (Avenue Fonsny)
• Code postal : 1060
• Ville : Bruxelles
Voulez-vous d'autres informations ou une action spécifique concernant cette adresse ?

où se trouve-t-elle ?

Used TomTom

Used TomTom

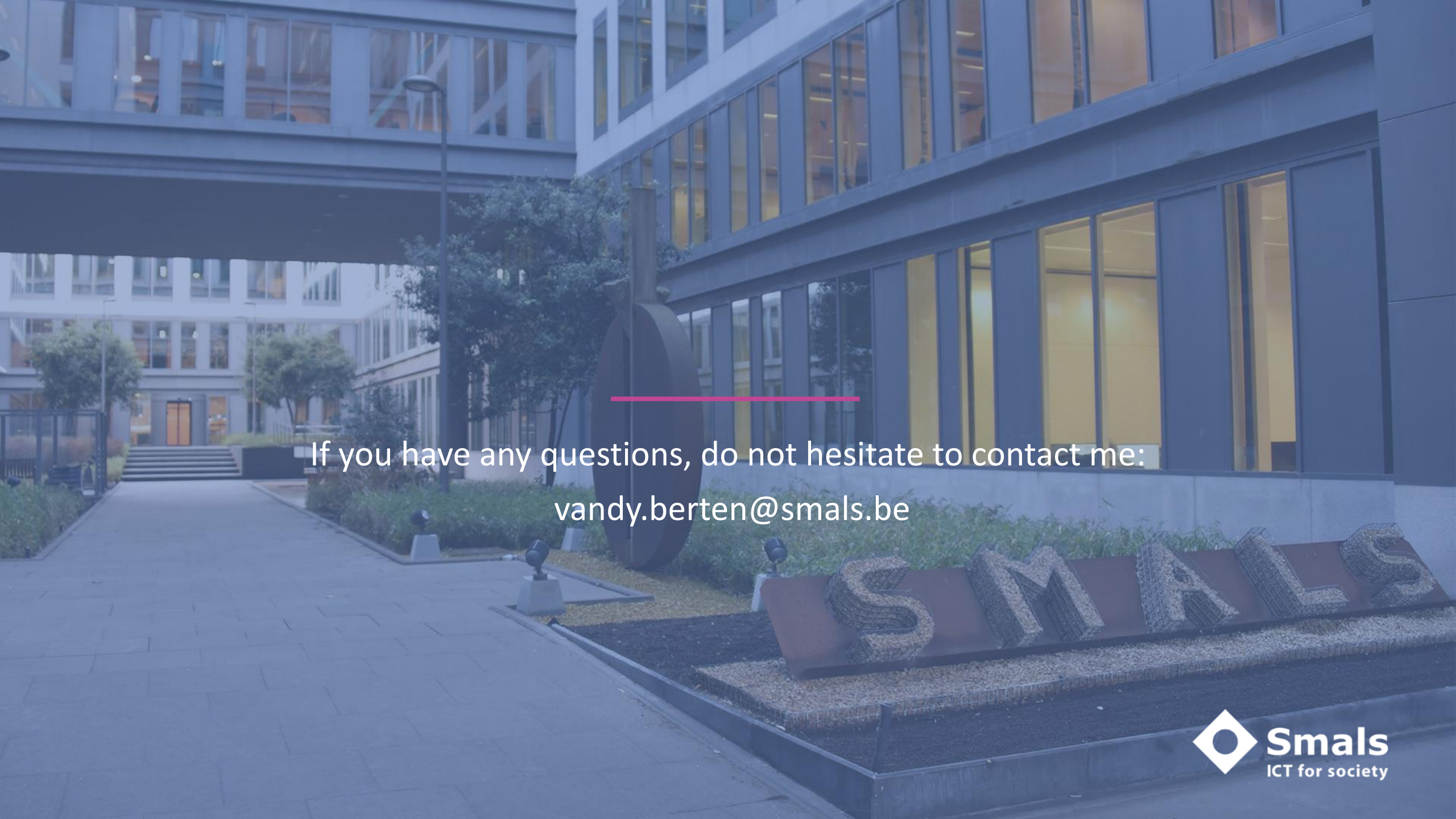
L'adresse "Avenue Fonsny 20, 1060 Bruxelles" se trouve à Saint-Gilles, Bruxelles, en Belgique. Voici une **prévisualisation de la carte** montrant l'emplacement exact :



Cloud solutions	Variable quality!	Easy set-up Worldwide	GDPR limitations Requires internet access Costs for large volumes
Open source solutions	Not good enough for production apps	On premise Free usage	Requires infra & management
Adapted OS solutions	Based on OS solutions, but (almost) reach cloud solution quality	On premise Free usage	Requires infra, management & maintenance

Here	Good quality Easy set-up Free up to 30 000 calls/month Worldwide		GDPR limitations Requires internet access Not for large volumes	
NominatimWrapper	On premise Free usage Very fast	OpenStreetMap data Works for “any” country	Requires infra & maintenance	Often street level
PeliasPlus		Good quality BestAddress id/data		Not mature yet Only Belgium

- Choosing a good geocoder is a complex task!
- Pick a (good) cloud solution if you can!
- Hybrid solution is possible (tool 1 for Belgium, tool 2 for World)
- Focus on address standardization or geolocation can lead to different tools
- Follow the NGI geocoder project evolution!



If you have any questions, do not hesitate to contact me:

vandy.berten@smals.be

Smals
ICT for society